JAN 2 3 '57

VOLUME LXXVI July-December, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

INDEX

July-December, 1939

VOLUME LXXVI

PUBLISHED BY THE
NATIONAL GEOGRAPHIC SOCIETY
HUBBARD MEMORIAL HALL
WASHINGTON, D.C.

$3.50 A YEAR

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Articles and photographs are desired. For material which The Magazine can use, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches have solved secrets that have puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

The National Geographic Society-U. S. Navy Expedition camped on desert Canton Island in mid-Pacific and successfully photographed and observed the solar eclipse of 1937. The Society has taken part in many projects to increase knowledge of the sun.

The Society coöperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

The world's largest ice field and glacial system outside the Polar regions was discovered in Alaska by Bradford Washburn while making explorations for The Society and the Harvard Institute of Exploration, 1937-8.

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VOL. LXXVI, No. 1 WASHINGTON JULY, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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NEWS OF THE UNIVERSE

Mars Swings Nearer the Earth, Sunspots Wane, and a Giant New Telescopic Eye Soon Will Peer Into Unexplored Depths of Space

By F. Barrows Colton

VIOLENT, invisible outbursts of ultraviolet light on a near-by star, our Sun, are meddlers today in human affairs.

Hurtling through 93,000,000 miles of space, they may capriciously interfere when an ambassador telephones across the Atlantic to the President at a time of world crisis. Or, in a mellow mood, they may allow the world to hear easily the blessing of a newly crowned Pope.

Not only can the distant Sun upset our vaunted short-wave radio broadcasts, and even mar television images. Far out in the cold and awesome space around us many other things are happening that affect our daily lives.

Through limitless depths of distance, scientists are reaching out to the twinkling stars and using them as laboratories to learn more about the insides of atoms and to verify experiments made on the Earth.

STEEL-MAKING SECRETS FROM THE SKY

The hard nickel-iron alloy of meteorites, fused in some cataclysm far off in space, helped teach metallurgists how to make the tough steel armor plate of modern battleships.

Astronomy is more than a sleep-destroying hobby that is keeping increasing thousands of amateurs up nights to gaze through homemade telescopes (page 4). It is a practical science, used daily by the workaday world.

Astronomy pilots air liners, cargo steamers, and war fleets. It wakes us on time, helps us catch trains, brings the semi-monthly payday around on schedule.

We realize so well today the importance of the Sun, for example, that there are many astronomers whose entire job is to keep close watch upon its blazing disk, photograph it almost continuously with still and movie cameras, and measure the tiny variations in its heat.

RED MARS SWINGS UNUSUALLY CLOSE

The sky will be full of dramatic and important events this year and in the near future. Mars, one of the two other planets on which some astronomers suggest that life of some sort may exist, will come closer to the Earth on July 27, 1939 (36,000,000 miles), than it has been for 15 years. This event will provide a long-awaited opportunity to study Mars with the latest instruments and methods (Color Plate IV).

Sunspots, associated somehow with happenings on the Sun which affect our lives, have passed the peak of the eleven-year cycle through which they increase and decrease in numbers, and are now growing fewer.

As a result, we know that short-wave radio reception will begin to improve, the

Photograph courtesy Pan American Airways

STARS HELP GUIDE THE HUGE "YANKEE CLIPPER"

The navigating officer of the transatlantic flying boat takes a sight at the stars to check the course. A special glass-enclosed turret is built into the ship's wing so that the Sun or stars can be observed. The officer is using a bubble sextant, in which a spirit level provides an artificial horizon.

troublesome "magnetic storms" will rage less often, and fewer northern lights will be seen.*

Hermes, the little asteroid that came so close to Earth in 1937, is expected to swing toward us again early in 1940, though at a safe distance, renewing interest in what would happen if such a body should collide with the Earth. On October 1, 1940, there will be another total eclipse of the Sun, visible in parts of South America and South Africa, providing one more rare chance to probe secrets of the mighty star around which we circle like moths around a flame.*

*See "The Mystery of Auroras," National Geographic Magazine, May, 1939.

200-INCH EYE TO PENETRATE UNSEEN DEPTHS OF THE UNIVERSE

Most important of all, the giant new "eye" of the 200-inch telescope on Mount Palomar, California, is expected in 1940 or soon after to take its first look out into dark reaches of the Universe which up to now have been entirely unexplored. With a mirror more than 16 feet in diameter, this telescope is expected to penetrate so far out into space that it will photograph objects whose light, traveling 186,000 miles a second, takes a billion years to reach us (p. 3).

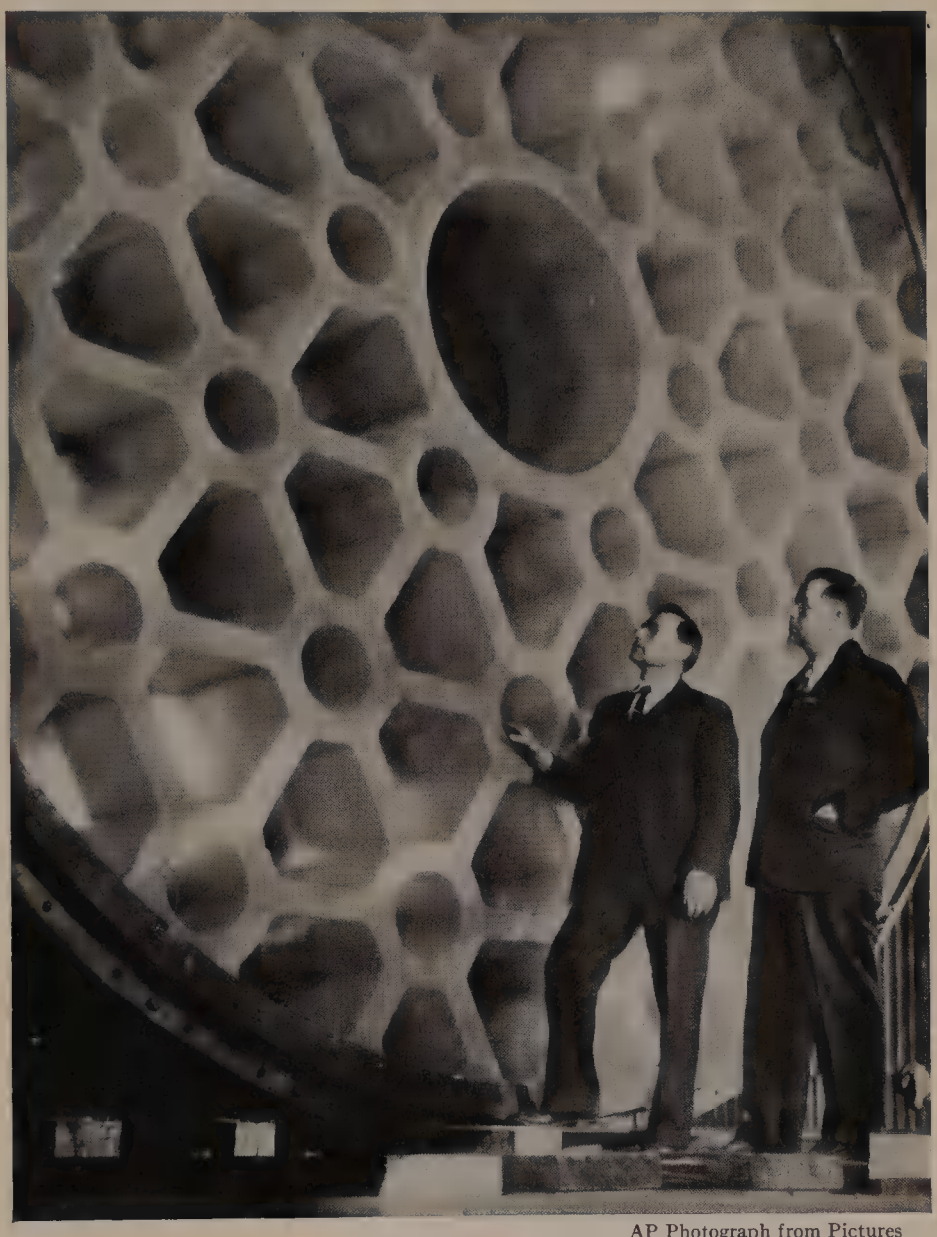
The 100-inch telescope at Mount Wilson Observatory, California, at present the world's largest, already has almost reached the limit to which it can penetrate into space, though its usefulness will never be ended. With it astronomers already have partially explored a section of the Universe shaped like an enormous hollow sphere, about six sextillion miles across.

But measuring the giant Universe in miles is like measuring the United States in trillionths of an inch! It is more con-

*See "Nature's Most Dramatic Spectacle," by S. A. Mitchell, and "Eclipse Adventures on a Desert Isle," by J. F. Hellweg, in the National Geographic Magazine for September, 1937.

venient to use a larger unit, the "light year," which is six trillion miles, the distance light travels in a year at its speed of 186,000 miles per second. The range of the Mount Wilson telescope is half a billion light years, so we can say that the "known" region of the Universe is one billion light years in diameter.

When the 200-inch telescope is turned upon the sky, this range will be about doubled and it is expected that astronomy will begin to take vast new strides. We shall be able to photograph and study stars and galaxies of stars that now lie hidden beyond our farthest horizons. We may learn once and for all whether the Universe is actually expanding, as it seems to be. We may even discover whether the Universe is infinite or has boundaries beyond which not even space or time exists!



AP Photograph from Pictures

THIS EYE COULD SPOT A CANDLE FLAME 40,000 MILES AWAY

The 200-inch mirror for the telescope on Mount Palomar, California, is expected to gather so much light that it will be possible to photograph galaxies a billion light years distant. Recesses in the mirror's rear reduce its weight from 40 to 20 tons. The telescope, world's largest, will be operated by California Institute of Technology with the cooperation of Mount Wilson Observatory (p. 2).

EARTH HITCHED TO A STAR

But before the new wonders begin to be revealed, now is a good time to look at the big show already going on, in that part of the Universe we already know. To call it "super-colossal" is a mammoth understatement!

Think of a huge hollow balloon, representing the region of space that has been explored up to now. Scattered inside it, like a giant swarm of bees, are 100 million enormous aggregations of stars, dust, and gas, called galaxies or nebulae, each one of tremendous size. Many of them are flat and round like a watch or coin, with arms spiraling out as from a Fourth-of-July pinwheel; some are globe-shaped; others oval.

These galaxies are turning like wheels, each one a rotating island of stars, dust, and gas, isolated in an immense ocean of nothingness far emptier than any earthly vacuum. Light from any average galaxy

Photograph by Joseph S. McCoy, Jr.

HOMEMADE TELESCOPES REVEAL THE HEAVENS TO AMATEUR ASTRONOMERS

The 6-inch reflecting telescopes were made by these men who are members of the National Capital Amateur Astronomers Association of Washington, D. C. They ground the mirrors, and most of the tubes are of sheet metal. The image of a star, planet, or the Moon is reflected from a large mirror to a prism and thence to the eyepiece in the side where the observer sees it.

travels two million years before it reaches the nearest neighboring galaxy.

In the midst of one of these galaxies—one of the flatter, thinner ones—is a yellow star, smaller than the average, just one among 30,000 million other stars in the galaxy. It happens to be our Sun. Circling around it are comets, asteroids, clouds of dust, and nine planets. One of the smaller of these planets is the little Earth on which we ride (Color Plate I).

This tiny globe of rock and iron, only 8,000 miles thick, is a mere speck in one great galaxy of stars. Yet, so far as we now know, it is the only place in explored space where intelligent life exists.

VAST KNOWLEDGE FROM MERE RAYS OF LIGHT

But though man must stay forever tied to the career of a single unimportant star, his mind is not so restricted. From the tiny one-celled organisms that were the beginnings of life on Earth has developed an intelligence that can explore a billion times six trillion miles out into the Universe.

And the mind of man has done all this with but a single tool, the rays of light. Except for a few facts gleaned from meteorites, we have gained our whole vast knowledge of the Universe from light, and light alone (Color Plate VII).

Just what light is, no one can surely say. But we do know that when it is split up into its different colors, or wave lengths, each wave length vibrates a different number of times per second, like the different notes on the piano. And each of the 92 elements of which the Universe is made will, when in a gaseous state, radiate or absorb light of different colors or wave lengths, an identification as positive and individual as a fingerprint.

So, taking the light of a distant star, we can split it into its different wave lengths, and they tell us positively that there are in that star, for example, oxygen, helium, hydrogen, sodium, or other familiar things. Moreover, we can photograph the spectrum, or split-up light of a star, and the resulting picture shows a series of lines, arranged like the rungs of a ladder. From

the position, spacing, intensity, and thickness of these lines, an astronomer can tell you, in many cases, the distance of that star, its mass, or weight, its brightness, its temperature, size, speed of rotation, and atmospheric pressure.

The giant mirrors of telescopes catch light that started toward Earth from the distant galaxies before the human race existed. These ancient light rays tell us that the farthest reaches of the Universe contain no materials different from those in our own bodies and our planet. Who, then, can say that man on his little Earth is insignificant?

Seen from outside, the Earth would be a globe colored about the same blue as our sky, largely covered by clouds (Plate I).

Outlines of some continents might be distinguishable at times, large patches of green would appear as spring came on, fading with autumn, and large white areas would surround the poles in winter.

The Earth is built like a golf ball, with a core of nickel-iron, an outer layer of heavy rock, and a thin skin of lighter rock. Oceans cover three-fourths of its surface.

HYPOTHETICAL BIRTH OF THE EARTH

It is certain that the Earth, other planets, and the Sun are related, for all are made of the same materials. Probably big masses of gas somehow were ripped off the Sun and started circling around it. Gradually they cooled and formed into the planets, one of the smaller ones becoming the Earth. All this happened in the distant past, for we know that the Earth's crust has been solid for about two billion years.

Perhaps the planets had two parents, the "mother" the Sun, and the "father" another star, according to the theory of Drs. F. R. Moulton and T. C. Chamberlin. The "father" star, if such there was, circled in close to the Sun, and possibly there was even a sideswiping collision.

In either case, while the two were close together great tides were raised on both by their mutual attraction. Vast masses of hot gas extended out into the space between them. The "father" star did not tarry, and, as he pulled away, his gravitational attraction detached much hot gaseous matter from the Sun. Some of it followed him off into space. The rest began revolving around the Sun.

A few of the larger gaseous masses then perhaps became the planets, with smaller fragments evolving into the moons, comets, asteroids, and meteors we see today. Or the planets may have been slowly built up by the joining of smaller fragments.

It may be, too, that the planets were born in a catastrophic breakup of the Sun, says Dr. Ross Gunn of the United States Naval Research Laboratory (Color Plate V). At some distant day when it was larger than now, the Sun may have gotten to spinning too fast to hold together. Some stars today apparently are on the verge of such a breakup.

First the spinning Sun developed huge bulges, according to this idea, making it lopsided. Then one of the bigger bulges broke clean away. At the same time, tides were raised on both the fragments, and masses of material were shot off from them.

As the Sun broke in two, the terrific heat of its interior was suddenly released, as when steam bursts from a hot potato cut in half. Both halves of the sundered Sun thus had hot faces from which rushed forth the light and energy which until then had been pent up inside.

As the recoil of ejected gases drives a rocket, the recoil of this outrushing energy drove apart the two halves of the Sun. The smaller one shot off into space to become a separate star. The other remained as the Sun we know today. The smaller fragments of ejected material began revolving around it and became the planets.

We know that stars sometimes do break up. Just recently a star known as Nova Pictoris split into three sections, and astronomers have been watching them fly apart at the rate of a million miles per hour.

If the Earth was created out of the Sun, by whatever means, we humans can truly say that we are the Sun's grandchildren, for we in turn are made of the Earth's materials. The atoms in a chorus girl's blond hair or in a beggar's ragged coat probably once danced in the flaming gases of our parent star.

THE MIRACLE OF LIFE APPEARS

In the deepest oil well drill hole man has scratched less than three miles into the Earth's outer skin of rock, but with the aid of earthquakes he has explored to its very center. It's an ill temblor that shakes nobody good! The vibrations of earthquakes that pass through the Earth's center show by their behavior that the central core must be a mass of nickel and iron, 4,000 miles thick.

© Robert H. Goddard

ROCKETS EVENTUALLY MAY EXPLORE HIGHER THAN STRATO-BALLOONS

A model designed by Prof. Robert H. Goddard of Clark University takes off from its 60-foot tower. He hopes to send instruments into the upper air by rocket to record temperature, pressure, and other data while returning by parachute.

About half a billion years ago the beginnings of life appeared on our ball of solidified gas. From where? Not long ago a scientist believed he had found living bacteria inside meteorites which had fallen upon the Earth. Were they living visitors from outer space? Did life come to Earth originally by similar means, from some other planet or distant star? Most astronomers doubt it. They are inclined to think that if there were bacteria in the meteorites they somehow got inside after the meteorites fell on Earth.

If life did not come from outside, it must have arisen spontaneously here, through some mysterious process of Nature.

Raining down from the Sun upon the outside of the Earth's air blanket is a never-ending shower of light, not only the visible light we see, but invisible ultraviolet rays. Some of them, if not screened out by a layer of ozone in the air, would destroy all earthly life.

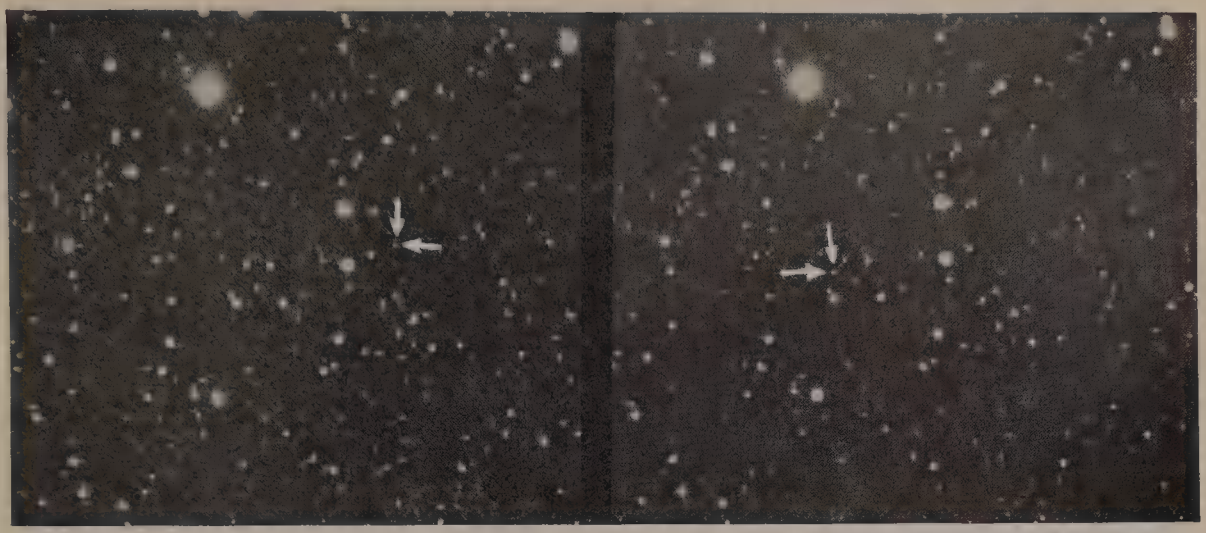
SOLAR OUTBURSTS BREAK RADIO "MIRROR"

Between 60 and 250 miles above Earth, other types of ultraviolet rays from the Sun are absorbed and there build up layers of electrified air, the "radio mirror," or ionosphere. It is a fine example of how our parent star affects the civilization of today. Though radio waves can go through a wall, they cannot (except ultra-short waves) penetrate these layers of electrified air. So, flashing up from the sending station, they are reflected back again to Earth, and thus travel in a series of huge bounces between Earth and sky, making possible long-distance radio communication.

But sudden outbursts of ultraviolet light and other radiations from the Sun sometimes upset this convenient arrangement. Their effect on the ionosphere is as disturbing as suddenly turning a garden hose on a man standing quietly under the gentle spray of a shower bath.

Under this sudden "hosing" the radio mirror often breaks. Programs and signals fade. The invisible shell of magnetic force that surrounds the Earth is upset and currents in the Earth are disturbed; news dispatches and telegraph messages traveling over wires are garbled. Some of these disturbances are called magnetic storms. They are most frequent when sunspots are most numerous (pages 10 and 11).

Huge red masses of hot hydrogen gas also often flare up from the Sun's surface. Sometimes when this happens there is a



Photographs from Lowell Observatory

HOW PLUTO WAS FOUND—A WHITE DOT MOVES AMONG THE STARS

The ninth and most distant planet was discovered by comparing these two photographs of the same section of the sky taken six nights apart, on January 23, 1930 (right) and January 29 (left). Arrows point to the dot that represents Pluto. The movement indicates that the object was relatively nearer the Earth, and therefore must be a planet. The other white dots are stars, and show no movement between pictures because they are so far away (page 16).

complete fade-out of short-wave radio on the daylight side of Earth at the very instant the flare is seen. Eruptions of ultraviolet light shoot out from the hydrogen flares and interfere with the radio mirror.

FATES THAT MAY AWAIT THE EARTH

Our air blanket holds also a hint of Earth's future fate. Probably our planet once had twice as much oxygen in its air as now. Half of it already has been gradually absorbed by iron and organic matter in the Earth's crust, and the process is continuing. But we have enough oxygen remaining to last at least a billion years.

Other fates may overtake us. We may pass through a thick cloud of dust in space, whose friction would slow the Earth's velocity in its orbit. Then we would be drawn nearer the Sun until the increased heat destroyed life. Or the Sun may explode, as other stars occasionally do, destroying life in a flash. Or another star may pass so close as to disrupt the Sun and solar system. But there's much more chance of being hit by an automobile!

If the cold of some future ice age should become unbearable, and the remnants of mankind should escape by rocket to the Moon, they at least would find a terrific contrast—during daylight there the temperature is hotter than boiling water!

Experimental rockets already exist, and some scientists feel that eventually we may send a rocket to the Moon, though not carrying people. But no fuel known today can propel a rocket at nearly seven miles a second, the speed necessary to overcome the Earth's gravitational pull.

Without leaving the Earth, however, we have learned from delicate instruments that in "daytime" on the Moon the temperature is unbearably hot, whereas when darkness falls it drops to almost 200 degrees below zero Fahrenheit.

MOON'S MOUNTAINS RIVAL EVEREST

A topographic map of the side of the Moon that faces us is being made, showing heights of the weird mountain ranges, angles of slopes, and depths of the great craters. Moon mountain heights, some almost equaling Mount Everest, are measured by the lengths of their shadows.

Craters on the Moon range up to 140 miles across. Some probably were made by volcanic eruptions. Others may have been formed by large meteorites which hit at 100 times the speed of a rifle bullet, since there is no air to break their fall (page 31).

A fine powder of the nature of volcanic ash and pumice is the "make-up" on most of the Moon's face. Astronomers have learned this by noting how the vibrations of light waves are changed when they are reflected from various types of rocks.

As our Earth speeds along on its path around the Sun it follows a dusty and rocky road. We're constantly colliding with meteors and rocks that are flying through

space. Occasionally we even strike a mass of meteorites or a comet head on.

WHEN METEORITES HIT OUR PLANET

The last time this happened was in 1908. One day, in a remote part of Siberia, a huge, luminous mass roared down out of the sky. As it struck Earth, a blast of superheated air rushed out and for miles around the countryside was charred and seared as if by a giant blowtorch, while in every direction the forest trees were uprooted, with their trunks leaning away from the central area.

In the Arizona desert, too, several thousand years ago, the same thing happened, when a large mass of meteorites or a small comet fell and formed a crater 570 feet deep and nearly a mile across (Plate III and page 13).*

It almost happened again in 1937, on a vastly greater scale. The asteroid Hermes, about a mile in diameter, came within some 500,000 miles of the Earth, though its path was such that it could not have struck us. Should such a body fall on one of the world's great cities, it would dig a crater several miles wide where the city now stands, and the hot air blast would destroy all life and property for scores of miles around.

But most of the Earth's surface is still empty or sparsely populated. Should Hermes strike anywhere but in a thickly settled area, it would merely dig a crater, destroy vegetation, and cause an earthquake in the vicinity, if on land, or produce a great tidal wave if at sea.

Thousands of asteroids of all sizes are speeding around the Sun. The largest is 480 miles in diameter, as big as Texas, while others are no larger than small mountains. Most of them follow a path between the orbits of Mars and Jupiter, and are perhaps the remnants of another planet that broke up. Only a very few of the smallest have orbits such that they ever could collide with the Earth.

MESSENGERS FROM SPACE

But though we could seldom collide with an asteroid, we strike "rocks" fairly often. These are the meteorites, large enough not to be consumed by the heat generated by friction as they fall through our atmosphere.

They tell us two things: first, that all of the Universe apparently is made of the same materials as our own Earth, for no element not known to us ever has been found in a meteorite; and second, that strange processes of mineral-making take place out in the great beyond. The familiar elements contained in meteorites often are fused into new combinations not existing on Earth, by methods unknown to us.

These visitors also bring riches from the sky. A Colorado meteorite contains enough gold to make one good tooth filling. Others contain tiny but genuine diamonds. So sure are some astronomers that there is a fortune in platinum and iridium in the great mass of meteorites that made the Arizona crater that several once invested money in a project to dig them up!

Meteorites are of three kinds: iron, different from earthly iron; stone; and a mixture of the two. You can identify them by pockmarks, like thumbprints in a cake frosting, where softer materials have been melted out, and by a smooth, glossy surface resulting from heating. Also, they're heavy for their size (pages 29 and 32).

The ancient Phrygians worshiped a meteorite as "Cybele, mother of the gods." The sacred black stone in the southeast corner of the Kaaba, the holy place of Mecca, is believed to be one.

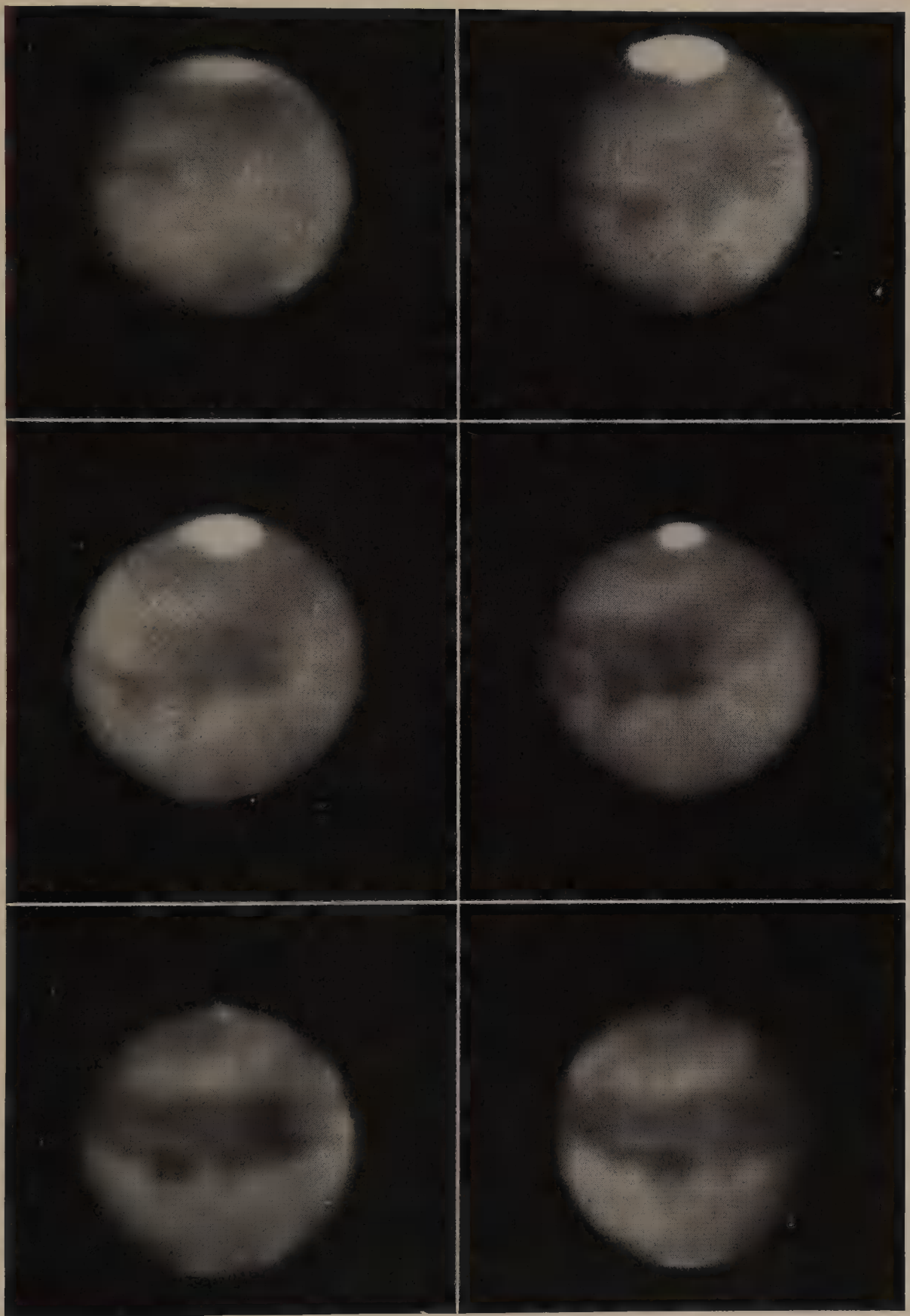
Smaller cousins of the meteorites are the countless tiny meteors. Every day the Earth collides with billions, most of them no bigger than a grain of sand.* As they speed into our atmosphere, its friction heats them and they burn to ash while they are still 40 miles or more above the Earth. All we see is a brief flash of light, a "shooting star."

Vast numbers of the meteors that the Earth "sweeps up" each day come from the real depths of space, from far out between the stars, beyond the solar system. But sometimes we plunge into a thicker cloud of meteors. Then for a few hours the night sky is filled with flashing lights. And that brings us to comets, for these thicker meteor swarms are the débris of comets that are dead or dying.

"From the Devil and the Comet, good Lord, deliver us," said an old prayer. In 1910, when it became known that the Earth would pass through the tail of

* See "Mysterious Tomb of a Giant Meteorite," by William D. Boutwell, in the NATIONAL GEOGRAPHIC MAGAZINE, June, 1928.

*See "Exploring the Ice Age in Antarctica," by Richard E. Byrd, in the NATIONAL GEOGRAPHIC MAGAZINE for October, 1935.



Photographs from Lowell Observatory

WHEN SPRING COMES ON MARS, THE POLAR CAP SHRINKS, GREEN AREAS GROW

Changes caused by advancing spring and summer are revealed strikingly in these telescopic photographs. Left to right, top to bottom, the pictures show how the white cap at the south pole (top of planet), probably snow, gradually dwindles. At the same time, dark, blue-green regions in the Martian tropics increase. Many astronomers believe this represents the growth of vegetation (Color Plate IV and page 14).

Photograph courtesy Carnegie Institution of Washington

SPOTS ON THE SUN MAY MEAN TROUBLE ON EARTH

Like gigantic tornadoes, sunspots are whirling vortices in the outer gaseous envelope of the Sun. They do not affect the Earth directly, but are "symptoms" of radiation outbursts from the Sun that interfere with short-wave radio and telegraph communication. Such disturbances are most frequent when sunspots are numerous (page 6). This group measures about ten times the diameter of the Earth.

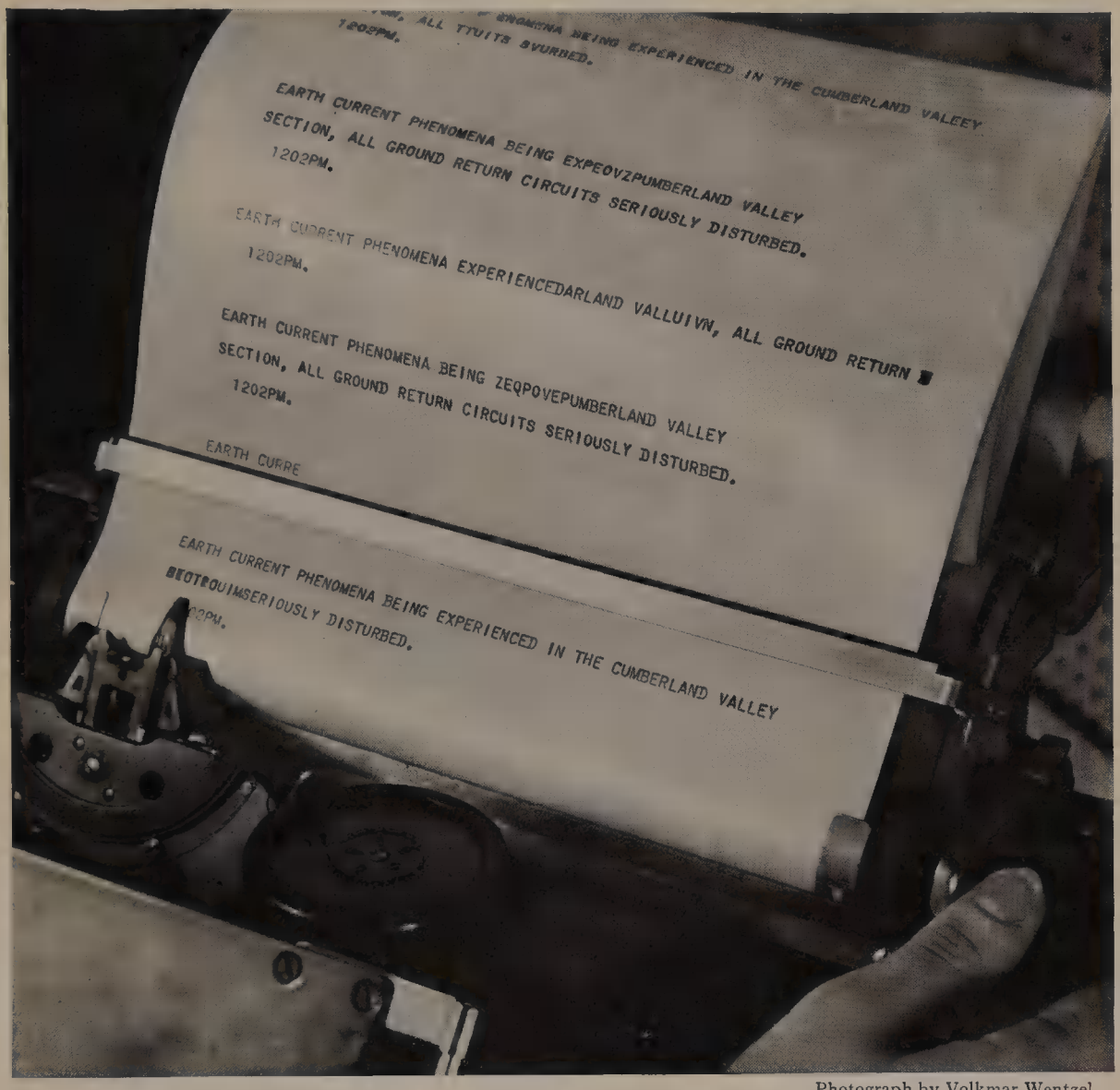
Halley's comet, some inhabitants of Asia Minor filled barrels with water in which to submerge, hoping thus to escape destruction. But the barrels were never used, for when we went through the tail nothing happened at all. And no wonder. A comet's tail contains less material per cubic inch than the best vacuum we can produce.

COLLISION WITH A COMET'S TAIL

Moreover, comets have no tails except when they come near the Sun (Plate VIII). The real comet consists of a nucleus of small pebbles, larger masses of rock or metal, dust and gas, surrounded by the "coma," a thin cloud of dust and gas. Seldom is the nucleus more than 500 miles thick, but the coma may be tens of thousands of miles in diameter.

Each comet speeds along an oval-shaped or elliptical orbit, one end of which circles the Sun, while the other end lies far out in space. Some comets follow comparatively short orbits, returning to swing around the Sun every few years, while others have such long paths that it takes them hundreds or thousands of years to complete one circuit.

As a comet approaches the Sun, the increasing heat makes the nucleus glow, and the gas around it expands. Then pressure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Photograph by Volkmar Wentzel

NO OPERATOR WILL LOSE HIS JOB BECAUSE THIS TELEGRAM WAS GARBLED—THE SUN DID IT!

The scrambling of the letters is the result of a magnetic storm, caused by outbursts of ultraviolet light and other radiations from the Sun, which upset electric currents on the Earth (page 6). Repeated attempts were made to send the teletype message, "Earth current phenomena being experienced in the Cumberland Valley. All ground return circuits seriously disturbed."

of the Sun's light (as real as any other kind of pressure) starts pushing gas and dust out behind the head. Thus the glowing tail is born, and it may grow to be 100 million miles long.

But the tail does not often stay behind. As the comet circles the Sun, the pressure of sunlight keeps the tail always pointing outward, so that finally, when the comet moves away again, the tail goes first.

Comets seem to be gradually wasting away. Each time they circle the Sun, some material "leaks" out to form the tail and is lost, though it keeps on trailing around the Sun behind the comet.

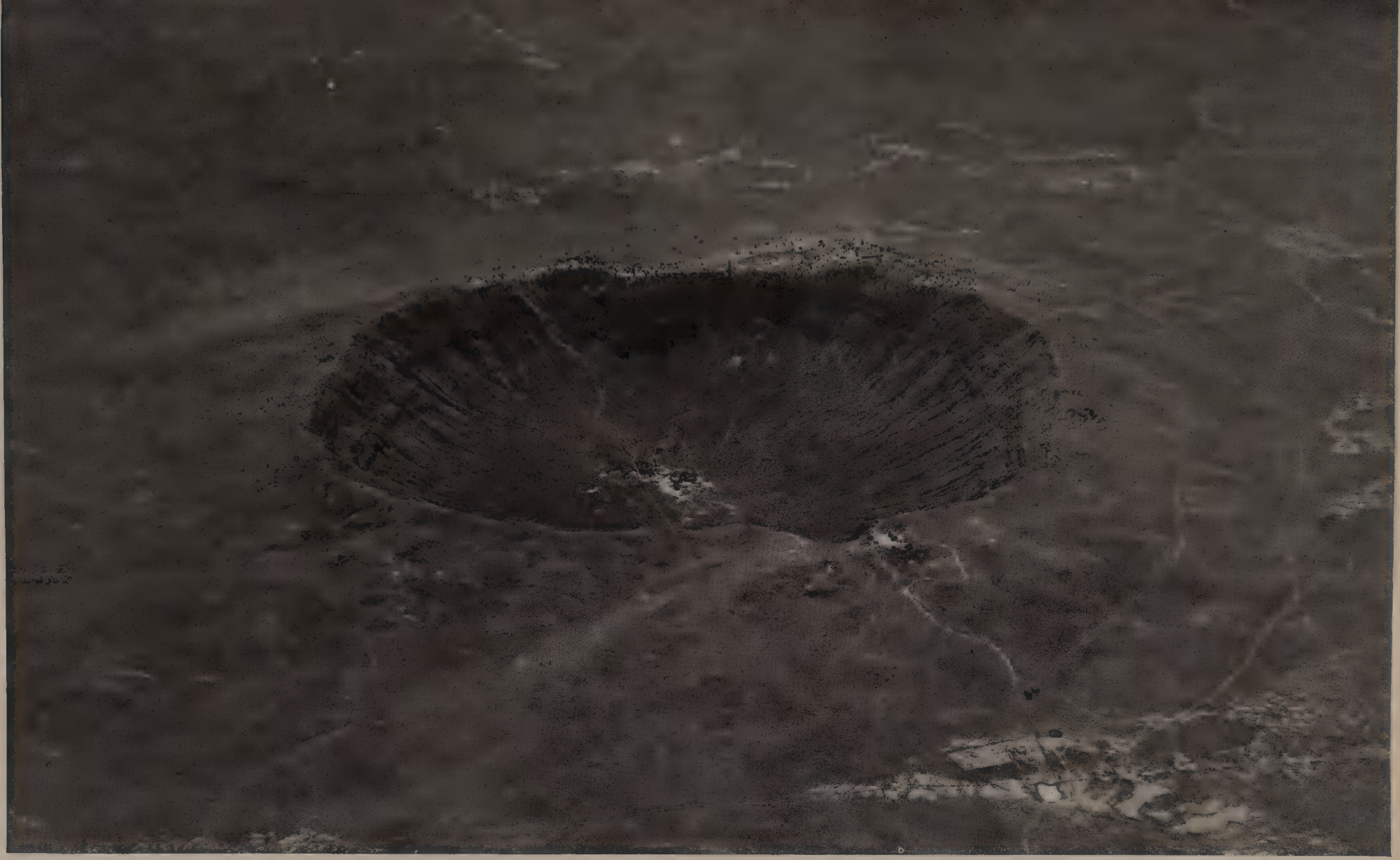
Astronomers actually witnessed the destruction of Biela's comet in 1846. As it neared the Sun, it broke into two parts which moved on together. Six years later, when it again came near the Sun, the two fragments were 1,500,000 miles apart. Since then, Biela's comet never has been seen again, but a vast swarm of meteors now circles through space in its old path.

Other comets, too, have failed to return, while clouds of meteors now speed along their former paths at 30 or 40 miles a second. So we know that many meteor swarms are just the fragments of old, worn-out comets, like the dust and broken bricks

Photograph from Wide World

THE SKY OF THE TIME OF CHRIST CAN BE SHOWN TO PLANETARIUM AUDIENCES

Images of the stars, Sun, Moon, planets, and Milky Way are thrown on the interior of the dome-shaped ceiling by the complicated projection machine dimly visible at left. A scale of months and days is being projected on the "sky" at the Hayden Planetarium in New York City.



Photograph by Major Albert W. Stevens

A GIGANTIC COLLISION BETWEEN THE EARTH AND A COMET OR GROUP OF METEORITES DUG THIS MIGHTY DIMPLE IN ARIZONA

Known as Meteor Crater, the gaping hole in the desert twenty miles from Winslow is three miles in circumference, nearly a mile across, and 570 feet deep (Color Plate III and page 8). Its rim rises 150 feet above the surrounding plain. Probably several huge masses of material struck here at once, penetrated deep into the ground, and then exploded, forming the crater.

that remain when an old house collapses.

Many comets which still exist have swarms of meteors scattered out behind, like a cloud of dust behind a speeding car. The Aquarids, a meteor swarm which we meet in early May, move in nearly the same orbit as the famous Halley's comet, and probably represent its "cloud of dust." The Perseid meteors, seen about August 11, follow the path of Tuttle's comet; the Leonids, seen in mid-November, follow the orbit of Tempel's.

THE EARTH'S EIGHT NEIGHBOR WORLDS

But while the meteor showers fall, let's turn to more important things—those eight other worlds that circle with us on the solar system merry-go-round. The other planets —is there life on them? Will we ever visit them in space ships?

Near the Sun are four small planets, in this order outward—Mercury, Venus, Earth, Mars. Farther out are four giant ones—Jupiter, Saturn, Uranus, Neptune. Then far beyond them all, forlornly alone in the outer void, is tiny, mysterious Pluto.

Closest to the Sun moves yellowish Mercury, not much bigger than the Moon. It is two-thirds nearer the Sun than we, exposed to blistering heat, and keeps always the same face turned toward the Sun, so the heat accumulates enormously upon it.

If there are oceans and lakes on Mercury, they are of molten lead, bismuth, and sulphur, for the temperature is around 600 degrees Fahrenheit, hot enough to melt any of these metals. On the other side, where the Sun never shines, the cold must be equally severe. Mercury has no air, the terrific heat having long since boiled it away. Life upon it is impossible.

Like a harem beauty, Venus, the next in order, hides her face behind a perpetual veil of clouds. If she has inhabitants, they probably never have seen the stars nor the beauty of a clear, sunny day.

Venus is about Earth's size, but 26,000,000 miles closer to the Sun than we, and hence much warmer. She shows no signs of having water, so her clouds are probably different from ours, perhaps mostly dust. They contain a vast amount of carbon dioxide, far more than in earthly air.

This gas might have been produced by decomposition of vegetation that perhaps formerly existed on Venus, but it seems unlikely that many plants, if any, exist there now or they would have absorbed the carbon dioxide. Plants also would need oxygen, which has not been detected on Venus. Her surface probably is a glorified dust bowl, with barren soil stripped by the wind.

FASCINATING MARS AND ITS "CANALS"

Next comes Earth, and then Mars, most fascinating of all the planets (Color Plate IV). Mars is a little rusty-red world, only about half the diameter of Earth, swinging through space 48,000,000 miles farther out from the Sun. Great deserts of reddish sand cover most of Mars. At both poles are white round caps of snow and ice, like those of Earth, which grow larger in the Martian winter and shrink in summer (page 9). Water is scarce, and the ice in the polar caps is probably only a foot or two thick.

Over much of Mars' surface are strange lines and markings. The first astronomer who saw them was an Italian and he called them "canali." The word can be translated either as "channels" or "canals."

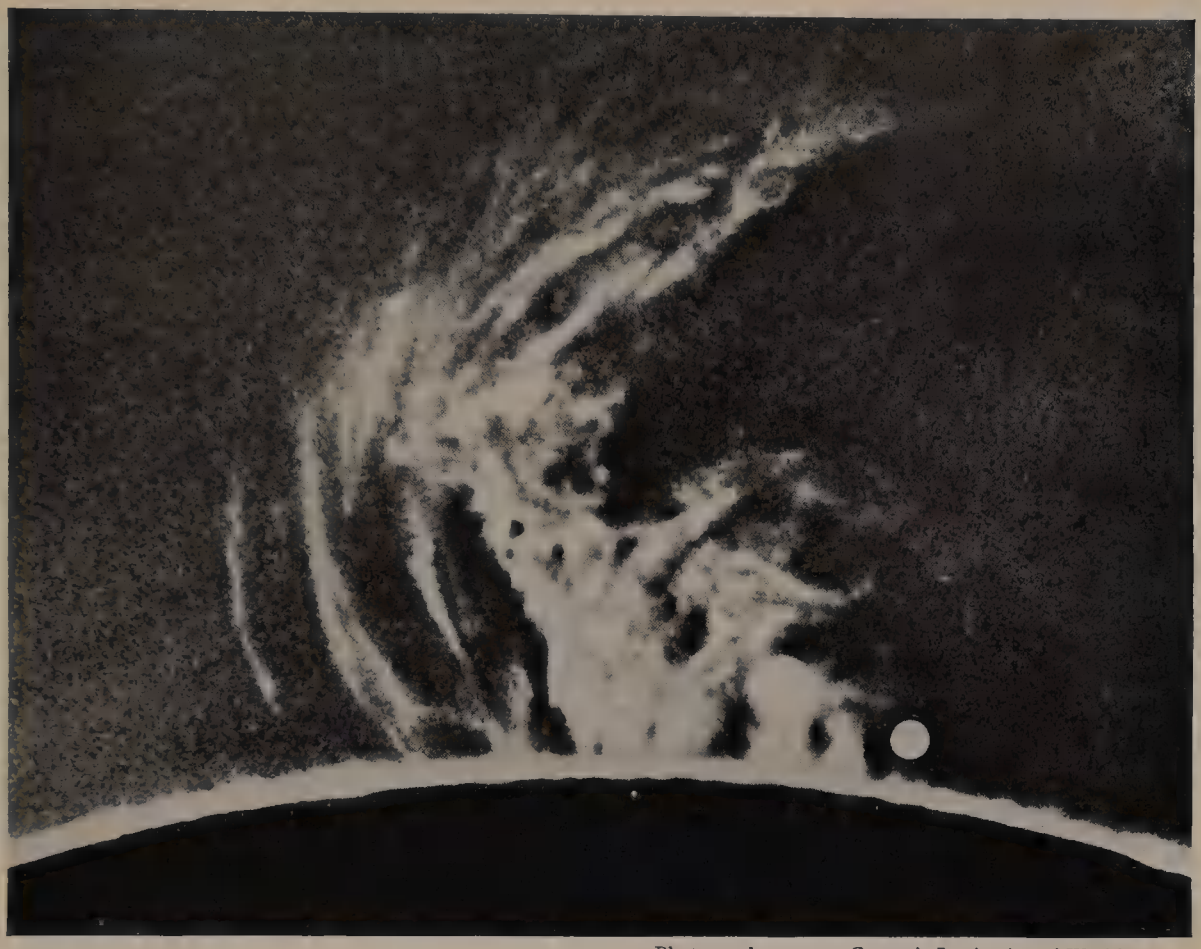
The lines look too straight and sharp to be natural streams. Some of them are 1,500 miles long and cross almost at right angles, which natural streams don't do. The late Dr. Percival Lowell believed the lines to be strips of vegetation along canals built by intelligent beings to bring water down from the melting ice caps to fertilize the deserts. He pictured Mars as a planet gradually drying up, while its surviving inhabitants struggled to keep alive by irrigating their fields from an ever-dwindling water supply.

Few others agreed with him. But some astronomers think that the lines may be natural stream courses through the desert with vegetation along their banks. The Nile Valley, with strips of green bordering the river, would appear much the same from a distance.

COLOR PATCHES MAY BE VEGETATION

But the best evidence that at least some form of life exists on Mars is furnished by the great patches of greenish-blue color here and there in the desert. They grow larger and darker as spring and summer come on in the Martian hemispheres, then turn yellower and fade with autumn, which seems to indicate that they may be patches of vegetation.

And this vegetation, if such it be, is a highly developed, hardy kind, evolved



Photograph courtesy Carnegie Institution of Washington

GIANT OUTBURSTS OF GAS ON THE SUN WOULD DWARF OUR LITTLE EARTH

The gaseous flare photographed rising from the Sun is 140,000 miles high. A white disk shows how small the Earth would be in comparison. Such flare-ups, known as prominences, take place constantly on the Sun, and have risen as high as 950,000 miles. Still and motion pictures of such solar happenings are made at several observatories whenever weather permits.

through ages of evolution on Mars to adapt itself to conditions there.

On Mars we may see dramatized the future fate of Earth. Gradually our own oxygen is being absorbed by the Earth's crust. On Mars this process may have gone much farther. There is only 1/1,000th as much oxygen in the air of Mars as in ours. Most of it has combined with iron to give the planet its reddish iron-rust color.

Mars has no sign of animal or "human" life. Its air is highly rarefied. If man could adapt himself to living on the top of Mount Everest, he might be able eventually to learn to live on Mars. Since Mars's gravity is small, a 150-pound Earth man would weigh only 57 pounds on Mars and would need little strength to move about.

But he would need plenty of blankets. Even in midsummer at high noon, the temperature rises only to about 60° F. on Mars, while at night it turns suddenly cold and may drop to 40° below zero or more.

Would you like to breathe "air" composed of ammonia, which brings tears to your eyes, and methane, which is found in illuminating gas and in firedamp, the cause of coal-mine explosions? These gases are believed to exist on the four huge outer planets, rotating at terrific speeds as they circle slowly around the Sun.

PLANETS WITH SHELLS OF "ICE"

Too far from the Sun to receive much light or heat, life upon these weird worlds is impossible. Their central cores are of rock or metal, probably iron. Around the cores are great shells of ice, thousands of miles thick, but far different from the ice we know. Above the ice lie deep atmospheres of ammonia, methane, and hydrogen.

Jupiter, largest of the planets, 87,000 miles in diameter, weighs more than all the others combined. Just a year ago Dr. Seth B. Nicholson, with the 100-inch telescope at Mount Wilson, found two more moons

circling Jupiter besides the nine already known.

A cataclysmic crumbling of one or more moons probably produced the "rings" of Saturn, next beyond Jupiter outward from the Sun. The terrific gravitational pull of the parent planet, it is believed, caused the luckless moons to disintegrate. The three flat rings, only 10 miles thick, but 41,500 miles wide, are composed of millions of tiny moon-fragments circling together around the planet (Color Plate II). Nine other larger individual moons, still intact, move around Saturn farther out.

Uranus and Neptune are so far away that little is known about them, save that they are of much the same construction as Jupiter and Saturn.

HOW A NEW WORLD WAS FOUND

Early in this century astronomers noticed that Uranus had an unexplained "waver" in its orbit. Dr. Percival Lowell, founder of Lowell Observatory, Flagstaff, Arizona, suspected that the gravitational pull of an undiscovered planet was the cause. In 1915 he announced his definite belief that such a planet existed, and predicted where it would be found.

To look for the planet, a certain region of the sky was divided into sections, and each section photographed twice, a few nights apart. When the two pictures of each section were compared, the stars in them would not have changed position, but a planet, being much nearer the Earth, would have moved noticeably (page 7).

Dr. Lowell began the search before his death in 1916. The hunt was resumed in 1929, with improved equipment. Clyde Tombaugh, a young assistant at Lowell, was taught to make and compare the photographs. On February 18, 1930, he found that a point of light in one of the sections of the sky had moved between pictures. The orbit and behavior of this body proved to be very close to what Dr. Lowell had predicted. It was the long-sought ninth planet, nearly four billion miles from the Sun.

"Solar System's Eternal Show"

The eight astronomical pictures accompanying this article were painted by Charles Bittinger, of Washington, D. C., a pioneer in the field of scientific painting.

In these paintings Mr. Bittinger has combined a fine sense of color values and artistic composition with a painstaking effort to achieve scientific accuracy. Small details of shadows and angles in the pictures, hardly noticeable to the layman, were worked out by the artist as carefully as the more obvious features. In this he received valuable assistance from members of the staffs of the United States Naval Observatory, Mount Wilson Observatory, Pasadena, California, Lowell Observatory, Flagstaff, Arizona, and the National Bureau of Standards.

In 1937 Mr. Bittinger was a member of the National Geographic Society-U. S. Navy Eclipse Expedition to Canton Island in the Pacific Ocean to observe the total eclipse of the Sun on June 8 of that year. He executed an impressive painting of the eclipse, which was reproduced in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1938, and is now on exhibit at the New York World's Fair.

Originally Mr. Bittinger planned a career in physics, and devoted three years to study at the Massachusetts Institute of Technology. But an increasing interest in art led him to change his plans, and he spent four years at the École des Beaux Arts in Paris. Paintings by Charles Bittinger now hang in the National Arts Club of New York, the Art Museum of St. Louis, the Boston Athenæum, and the Metropolitan Museum of New York. He is a member of the National Academy of Design, election to which is one of the highest honors in American art, and winner of many prizes and awards.

Mr. Bittinger has pioneered in "changeable paintings." Such a painting may appear as a portrait when illuminated by ordinary light, but changes to a landscape when light from a different part of the spectrum is thrown upon it. On the walls of a room at the Franklin Institute in Philadelphia are three murals done by him in fluorescent paints, visible only when ultraviolet light is thrown upon them. Under ordinary light the walls appear white.

A beautiful painting of the spectrum of the Sun, by Mr. Bittinger, adorns the National Academy of Sciences building in Washington.

The solar spectrum in Webster's New International Dictionary of the English Language was painted by Mr. Bittinger.

"In planning and working out the paintings which accompany this article," said Mr. Bittinger, "I came to feel more than ever that astronomy is the greatest monument to human intelligence, which has explored out into unimaginable depths of space with nothing more tangible than the fragile waves of light.

"Astronomy gives us, as nothing else can, an appreciation of the power and wisdom of the unseen hand of the Creator which has produced and governs this stupendous Universe."

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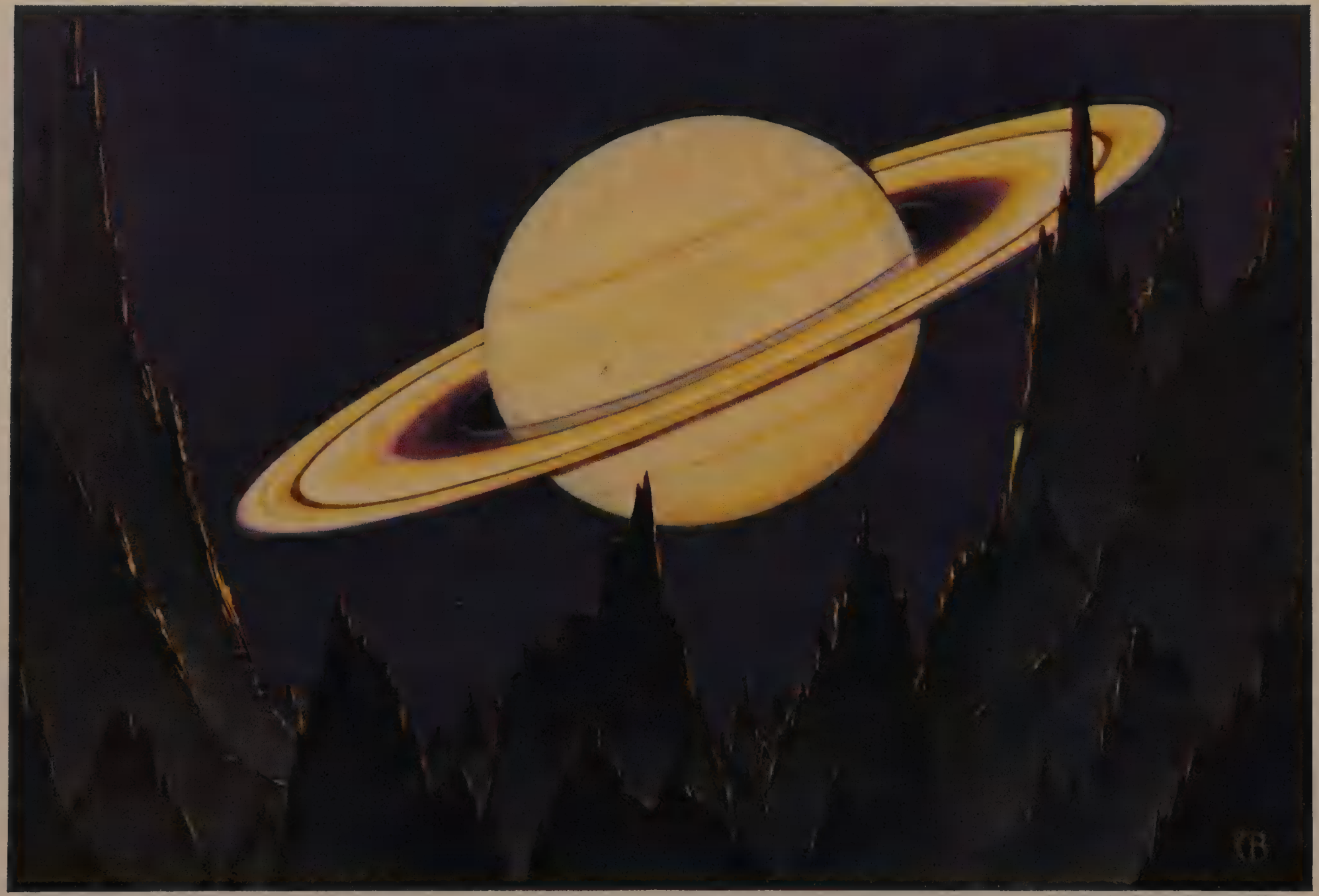
Painting by Charles Bittinger, N. A.

A BLUE GLOBE HANGING IN SPACE—THE EARTH AS SEEN FROM THE MOON

Our planet is this color because it is enveloped by the same "blue sky"—really air—which we see from beneath. The atmosphere scatters blue light rays more than others. Continents would be faintly visible if the day on Earth were cloudless, as depicted here. The white patches are the polar ice caps. In the foreground is the Moon's surface, with its craters and mountains. From the Moon the sky appears black because there is no atmosphere to scatter sunlight and modify its actual appearance.



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Painting by Charles Bittinger, N. A.

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Painting by Charles Bittinger, N. A.

ROARING IN FROM OUTER SPACE, A HUGE METEORITE OR SMALL COMET DUG ARIZONA'S GREAT METEOR CRATER

Red-hot on the outside from the friction of its passage through the atmosphere, the million-ton mass appeared somewhat like this as it struck the Earth at terrific speed. The constellation of Orion is shown at upper right.

© National Geographic Society Painting by Charles Bittinger, N. A.

THE ONLY LIFE OUTSIDE THE EARTH MAY EXIST IN MARS' GREEN PATCHES

Many astronomers think they are some form of vegetation, for they appear and disappear with the changing Martian seasons. The planet is seen here from Phobos, the nearer of its two moons. Spring prevails on the upper half of the globe, so the white polar ice cap has shrunk considerably. At lower right are some of the famous "canals." Vast areas of Mars are deserts whose soil has turned rusty red, probably through absorption of oxygen from its atmosphere. Mars' diameter is about half that of the Earth. It is extremely doubtful that there are any "Martians" in existence.

IN A BREAKUP OF THE SUN, THE EARTH AND PLANETS MAY HAVE BEEN BORN

In the distant past, according to one theory, the Sun was rotating so fast that it began to fly apart. Huge bulges developed on it, as shown here.

AS THE SUN BROKE INTO TWO STARS, SMALLER FRAGMENTS ALSO WERE EJECTED

These became the planets. Tidal forces slowed down the rotation of the two large masses, and some of their momentum was transferred to the newborn worlds.

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Paintings by Charles Bittinger, N. A.

LEAVING THE SUN (BELOW), THE OTHER STAR SPED AWAY INTO SPACE

When the original Sun broke in half, terrific light burst from the hot faces that were exposed. The force of this light drove the two masses apart by recoil, like skyrockets.

© National Geographic Society

Painting by Charles Bittinger, N. A.

AN ECLIPSE OF THE SUN BY THE EARTH, WHICH WE CAN NEVER SEE, WOULD BE VISIBLE TO A MAN ON THE MOON

Sunlight shining through the Earth's atmosphere from behind forms a red ring around our planet. Streamers of the Sun's corona show, at right, where the Sun is about to reappear. The luminous cloud is the "zodiacal light," believed to be reflected from small particles surrounding the Sun. Continents on the Earth and the north polar ice cap are faintly illuminated by moonlight. In the foreground is the Moon landscape (Plate I).

© National Geographic Society

Painting by Charles Bittinger, N. A.

LIGHT, HERE SHOWN SPLIT INTO ITS SPECTRUM OF COLORS, HAS TAUGHT US ALMOST ALL WE KNOW OF THE UNIVERSE

In this demonstration a reflected beam of sunlight, entering through a slot at the window, is broken up by the prism and thrown on the screen.

© National Geographic Society Painting by Charles Bittinger, N. A.

WHEN NEARING THE SUN, A COMET GROWS A TEMPORARY TAIL

This one is seen at dawn behind the Washington Monument, though actually millions of miles away. When one of these mysterious wanderers approaches the Sun, the pressure of solar radiation, as real as the pressure of a fire hose, pushes a tenuous cloud of matter out of the comet's head to form the tail. This appendage disappears when the comet returns to outer space, however. Orion's Belt is visible at the upper right, and the bright reddish star at upper left is the giant Betelgeuse.

Pluto probably is smaller than the Earth, without air, and chilled by a cold of 200 degrees below zero. No wonder it was named for the god of the lower world.

Do we ever get signals from other planets? No, say the astronomers, for there's probably no one to send them. Will we ever visit other planets, by "space ships"? Again the answer is no. Only on Mars and Venus is there any possibility that men could survive even if they landed safely.

Martians, setting out to attack Earth, assuming their space ships could move at meteor speeds, would have to travel for days through the 400-below-zero cold of space. Then, as they dashed into the Earth's atmosphere, they would have to endure sudden terrific heat for two or three seconds as their ships were heated to flaming incandescence by the friction of the air.

SUN'S HEAT WOULD TURN ROCKS TO VAPOR

To a man on Pluto the Sun would appear as an extremely brilliant star, and a star is what it is, the type known to astronomers as a "yellow dwarf." Our Earth is tied to the Sun by a gravitational pull as strong as 10,000,000 steel cables one mile thick. And we would not want to get away, for the Sun feeds us, warms us, keeps us alive.

After shining countless ages the Sun is still so hot that an ordinary 25-cent piece, heated to the temperature of the Sun's center, would shrivel up everything within thousands of miles. Even the outside of the Sun is heated to about 10,000 degrees Fahrenheit, a temperature at which the hardest rocks and metals not only melt but turn to vapor.

The Sun is slowly losing its heat, but will keep on shining about as it is now for billions of years more. It is a ball of superheated gas, 864,000 miles thick. Even at the center, where the pressure is something like 5,000,000 tons to the square inch, it is still a gas, though the atoms in the gas are very tightly packed together.

Despite this great heat, the Sun is not burning. One of two things is probably happening to produce its enormous energy —either the complete destruction of atoms, or the creation of them, perhaps both. Within the Sun's interior, the terrific heat sends atoms and electrons rushing about at breakneck speed. Constantly they collide. Sometimes both are destroyed, releasing the energy that held them together.

Remember that heat is a form of energy. Destroying the atoms in a thimbleful of water would release as much power as burning several thousand tons of coal. Perhaps, also, atoms of hydrogen, the gas that exploded in the dirigible *Hindenburg,* are being turned into helium, the nonexplosive gas, in the Sun. If so, great energy would be left over from the process to add to the Sun's heat.

Enormous whirling vortices of gas, the sunspots, thousands of miles wide, issue from the Sun's hot interior. Nobody knows their origin.

HARNESSING THE SUN'S ENERGY

Does the Sun cause weather changes? Dr. Charles G. Abbot, secretary of the Smithsonian Institution, has measured slight daily variations in the Sun's heat over many years. He believes they are the main cause of weather and that it might be predicted two weeks in advance if we had more complete and accurate data about the Sun.

In the meantime, practical steps are being taken to make more and better use of the vast energy that the Sun is sending to us.

An engine powered by the Sun's heat concentrated by mirrors has been invented and will run a boiler. Homes in Florida and California have hot water heated by solar heaters.

Methods of making trees grow faster are being studied, in hopes of speeding up the conversion of solar energy into a form we humans can use. Ways to use Sun heat to run engines for mechanical power, to change solar radiation into electrical energy, to convert sunlight chemically into forms available for work, are being sought by other researchers. The Sun shines almost steadily in the deserts, so some time they may become the new centers of the world's industry, as we learn to utilize the Sun as a chief source of power.

MILKY WAY A MIGHTY WHEEL OF STARS

Meanwhile, the Sun moves along, with its planets, through the Milky Way Galaxy, the great system of stars in which we live. This galaxy is a huge, round, flat conglomeration of bright stars, dark stars, dust, and gas. It is shaped much like a solid cartwheel, with a large bulging hub at the center, and is rotating (pages 26 and 27). Probably it has two or more arms

Photograph courtesy Carnegie Institution of Washington

SEEN EDGE ON, THIS GALAXY IS FLAT WITH BULGING HUB

Like our own Milky Way, it probably rotates wheel-fashion around its shining hub of gas and stars (page 25). Its mottled appearance results from dark clouds of dust and gas mixed with millions of shining stars and luminous gas clouds. Seen flat side on, it probably would appear like the one opposite.

beginning to fly off from the outer rim, like a Fourth-of-July pinwheel.

Our Sun is about halfway out from the hub of the wheel toward the outer rim. Look up at night at the Milky Way and you will be looking out toward the outer rim of the wheel. The Milky Way appears as a band of light across the sky because you are looking up through the thickness of the wheel and seeing the concentrated light of all the vast numbers of stars between you and the "tire."

In summer, if you look toward the constellation Sagittarius, you will be looking toward the hub of the Milky Way wheel. In that direction the Milky Way divides, split in two by a cloud of dark dust and gas which lies near the hub. Today, using infrared-sensitive plates, astronomers are penetrating this dark curtain and photographing stars that lie in and beyond the hub — 50,000 light years or more away.

Our great star-wheel is about 600,000,000,000,000,000 miles in diameter — light from a star on one edge would take 100,000 years to travel across to the other. The thickness of the wheel is some 10,000 light years. As the wheel turns, it carries the Sun along at nearly 200 miles a second, but so enormous is the wheel that it takes 200 million years to revolve. Our Earth, since it was formed, has traveled with the Sun around the wheel at least 10 times.

The wheel is built somewhat like a huge, round ham sandwich—two outer layers of stars corresponding to the bread, enclosing a middle layer of dark dust and gas representing the ham. But the "bread" is very crumby and the "ham" chopped very fine, for there are many stars mixed with the dark matter in the center, and much dark matter mixed with the stars in the two outer layers. Altogether, the substance or mass of the dark dust, dark stars, and gas

Photograph courtesy Carnegie Institution of Washington

FROM AFAR, OUR MILKY WAY PROBABLY WOULD LOOK LIKE THIS

Resembling a Fourth-of-July pinwheel, this distant galaxy is believed to contain millions of stars and clouds of dust and gas, rotating around the central hub (see opposite).

in the wheel is about the same as that of the stars that shine. Forming a sort of open-work sphere around the wheel are about 100 large globular clusters of stars.

SPOONFUL OF STAR STUFF MIGHT WEIGH A TON

Amazing things go to make up this wheel-like Milky Way galaxy—stars that pulsate like gigantic hearts; double stars that spin around each other; stars shrunk together so tight that a spoonful of their material weighs as much as a truckload of ours.

So distant from us are the other stars in our galaxy that the total light we receive from all of them (except the Sun) is no more than we would get from a single candle 100 feet away. The nearest star, Proxima Centauri, is so far away that if you were traveling to it on an air liner at 100 miles an hour, and tipping the stewardess 50 cents a day, the trip would cost four billion dollars in tips alone.

Brightest star in the sky is Sirius. It has a strange "companion" revolving around it once every 50 years, and this companion is 2,000 times as heavy as gold.

Most stars range from 10,000,000 miles in diameter down to about 300,000, but there are some "super-giant" stars. One of the largest known is Epsilon Aurigae, nearly 2,600,000,000 miles across, so huge that if the Sun were placed at its center all the planets except Uranus, Neptune, and Pluto would be revolving inside it.

Whence came the stars? They probably were formed from clouds of dust and gas out in space, though whence came the dust and gas few astronomers are prepared to say. The process may still be going on.

Throughout their long lifetimes stars follow the opposite course to man's—they shrink instead of grow. "Young" stars are the giants, huge and cool and red, blown up like vast balloons by the pressure of light from inside, and thin and rarefied. Then gravitation starts to overcome that pressure, and they begin to shrink. At the same time they grow hotter, for they must give out the same amount of radiation from a much smaller area. Gradually their color changes from red to blue. The hottest stars of all are blue.

"WHITE DWARFS" MYSTIFY ASTRONOMERS

Finally the shrinking star begins to grow cooler again and its color returns to red. Some day our Sun, now a yellow star, is expected to turn red as it keeps on cooling. At last the evolving star shrinks to a size

much smaller than our Sun and finally becomes a cold, dark, solid mass, continuing to circle on in the wheel of the Milky Way.

A mystery to astronomers are the stars known as "white dwarfs." They are no bigger than the Earth; they have shrunk together until a cubic inch of one may weigh several tons; yet instead of being cool they are fiercely hot—in fact, white hot.

The smallest star known is a white dwarf, not much bigger than the Moon, yet containing two and one-half times as much material as the Sun! Such tight packing is possible because the atoms in the star are broken up, just as you can pack more electric light bulbs in a box if you first smash them!

The white dwarfs are being intensively studied at Yerkes Observatory, Williams Bay, Wisconsin, and at the new McDonald Observatory, Mount Locke, Texas.

Twin, triplet, and even quadruplet stars are fairly common. About one in every three stars is double—really two stars revolving around each other, in periods ranging from a few hours to thousands of years.

By measuring the pull of double stars on each other, astronomers can determine their masses. From this we know that the average star contains something like two thousand million million million million tons of matter; yet all of this is gas!

Like flashing electric signs, some stars, the variables, flare up in brightness, then die down again, some at regular intervals, others on no set schedule. One such star, Chi Cygni, increases 10,000-fold in brightness from its minimum to its maximum!

Certain variable stars, the Cepheids (named for the star Delta in the constellation Cepheus) are good yardsticks of distance in the Universe. They wax and wane in brightness at regular intervals of four to 40 days. The more slowly they pulsate, the brighter they are. A Cepheid that varies up and down once a day is 100 times as bright as the Sun, while one that pulsates through a period of 10 days is 1,000 times the Sun's brightness.

If you know how much light a star gives out, you can tell its distance. So, seeing a Cepheid star pulsating at a certain speed, either within our Milky Way or in some distant galaxy, astronomers at once know its brightness, and hence can tell how far away it is. In this way they measure the distance from our own galaxy to many other galaxies far out in space, in which they can photograph Cepheid variables flashing like distant lighthouses.

Just a few years ago, however, a new spectacle flared up before the astonished gaze of astronomers. This has been called "the most colossal catastrophe of matter which man has been privileged to witness." Known to astronomers as a "super-nova," it is the gigantic explosion of a star.

Ordinary exploding stars have been known for some time. They were called "novae" (Latin for new) because at first they were thought to be new stars. Now, however, we know they are ordinary stars that suddenly increase greatly in brightness because of an explosion. About 30 stars explode every year in our Milky Way.

But a super-nova is 1,000 times as bright as an ordinary nova. In one month it may radiate away as much light or energy as the Sun gives out in 23,000,000 years! A mystery of super-novae is that their light, when analyzed, shows that they contain matter in a state never before known, something outside all earthly experience.

What makes a star explode? Probably the energy being generated inside it suddenly increases greatly. It needs an outlet, so the star blows up. Thick layers of gas are shot off into space at 600 miles a second, gradually thin out and drift away, but the star is not entirely destroyed.

We soon may see a star explode much nearer the Earth than usual, though not close enough to be dangerous. The central star of the five that make the W in the constellation Cassiopeia has been increasing and decreasing in brightness in a puzzling manner. It may be getting ready to explode. If it does, it probably will become a spectacle unparalleled in astronomical history, sending us for several weeks perhaps as much light as the full Moon!

ICY COLD OF INTERSTELLAR SPACE

The mighty energy that keeps the stars shining is the same as is operating in our own Sun—the upbuilding or destruction of atoms, or both. Scientists dream of some day releasing and harnessing vast stores of subatomic energy—driving the *Queen Mary* across the Atlantic with the energy pent up in the atoms of only a spoonful of coal. Out in the stars such energy is already at work. From these giant seething test tubes we may learn secrets some day that will revolutionize our lives.

Out between the stars in our Milky Way,

Photograph by Volkmar Wentzel

THE RING-SHAPED METEORITE IS UNIQUE—THE SMALL ONE PROBABLY STRUCK A COW

"The Ring" fell in Pima County, Arizona, perhaps 300 years ago. It was used as an anvil by a blacksmith in the 1850s. The central part may have been burned out as the iron roared through the air (page 8). The small stony meteorite held by the lad came to earth at Chicora, Pennsylvania, June 24, 1938. After it fell, a cow near by was found to have a downward tear in her hide. Both meteorites are in the U. S. National Museum, Washington, D. C.

we are exploring successfully the enormous depths of space. There the temperature is only a little above the "coldest cold," absolute zero, about 459 degrees below zero Fahrenheit. It is not completely dark—there is more starlight than the Earth receives. Great clouds of dust and gas are scattered there, but so vast is the space in which they are spread that there is only about one atom to the cubic inch, a far greater vacuum than any known on Earth.

In this dust, in space, astronomers now are recognizing familiar substances—sodium, which you find in table salt; calcium, used in making acetylene gas; titanium, used in paints and dyes; and faintly shining masses of hydrogen and oxygen.

Outside our giant "island" of the Milky Way stretches a far greater ocean of space, emptier even than the space between the stars. Scattered through this outer space are more "island" galaxies, like ours, or roughly similar. Sometimes they are called "nebulae," but this term is also used for gas clouds in our own galaxy. It is less confusing to call these outer islands "galaxies."

The space between the galaxies is as near to complete nothingness as can well be imagined. Probably it contains almost no matter at all.

You can see our nearest important neighbor galaxy without a telescope. Look at the constellation of Andromeda and you will see a hazy patch of light half as

Photograph by Willard R. Culver

HE TIMES THE MARCHING STARS WITH A SPIDER THREAD

In measuring the precise moment when a star crosses a meridian in the sky, an astronomer keeps the star's image divided exactly in half by a wisp of spider web stretched across his telescope eyepiece. This transit circle is used by the U. S. Naval Observatory to determine the positions of the stars, Sun, Moon, and planets. The observations form a basis for predicting future motions of these bodies for such purposes as forecasting eclipses.

big as the full Moon. Actually of course it is far beyond the stars in the constellation. You see it as you might see a distant mountain peak through a clump of near-by trees. It is a galaxy very much like ours, a flat "wheel" of stars and gas, known as the "Great Nebula in Andromeda."

About 700,000 years ago, when man perhaps was just evolving from an animal-like state, light from this galaxy started toward Earth. It is just arriving now. We see this "neighbor" galaxy as it looked about 7,000 centuries in the past.

The Andromeda galaxy is only the nearest of millions of galaxies that seem to extend on indefinitely. The most distant ones appear as mere specks on astronomers' photographic plates; yet these specks are the images of great systems of stars.

About 100,000,000 galaxies are scattered in the space that we have explored around us. In them probably are many stars like our own Sun, perhaps with planets, even life, like ours.

The largest galaxies are 5 to 10 times the size of the smallest, though most of them are roughly the same size. A few are irregular clouds of stars and dust and gas, not rotating around any visible center. Others seem to be round balls of gas, with no stars visible in them; still others are elliptical, more flattened and also of gas, with some visible stars. Many are flat, round, and wheel-shaped, full of stars like the Andromeda galaxy and our own Milky Way, rotating around a protruding hub, with spiral arms flying off from the outer rim.

The most amazing thing that astronomers have discovered in recent years, however, is that this great Universe of galaxies seems to be expanding! All the galaxies apparently are flying apart, at terrific speed,

like the fragments of an exploding bomb. The most distant ones known are estimated to be racing off into space at the unimaginable speed of 50,000 miles per second! Our own galaxy is receding from the others also.

We cannot see the galaxies moving, but we have good reason to think they are. When a train speeds past you, blowing its whistle, the sound drops to a lower pitch as the train moves farther away. This is because the sound waves coming back to you are lengthened.

The same thing happens to light. When an object moves away from you, the light waves coming back from it to your eyes are lengthened, and so it looks slightly redder than it really is, for the red waves of light are the longest. This happens to light from the galaxies. Astronomers call this effect the "red shift," because in a photograph of the spectrum of a galaxy the ladderlike lines are shifted toward the red, or long wave length, end.

Photograph courtesy Carnegie Institution of Washington

NO WINDS OR RAINS CARESS THE MOON'S DEAD FACE

Our satellite is so small it has not enough gravitational pull to retain any appreciable atmosphere, so it has no water, no clouds, no air (page 7). Without air, too, it would be impossible to hear sounds or detect odors on the Moon. Vast craters, high mountains, and plains cover its visible surface. This view shows a part of the Moon at last quarter. To astronomers it is a nuisance, for its light interferes with photography of distant heavenly bodies.

It's hard to believe the Universe is "exploding," but the only other explanation, says Dr. Edwin P. Hubble, is that the "red shift" is caused by some new law of Nature not yet discovered, perhaps as important as gravity itself.

Where will it all end? Will the galaxies fly so far apart that we can no longer see them with telescopes, leaving the Milky Way "isolated" in space? Perhaps; or they may slow down and stop. Or the Universe may be alternately expanding and contracting, like an accordion!

These various possible—or impossible—kinds of Universes are worked out by mathematics. In the process strange ideas arise. Besides the familiar dimensions of length, breadth, and depth, we are told,

Photograph courtesy Field Museum of Natural History

LUCKILY, NO ONE WAS IN THE CAR WHEN THIS METEORITE STRUCK

The girl is holding a four-pound stone-from-the-sky which fell in Benld, Illinois, September 29, 1938, and now is on exhibition at the Field Museum of Natural History, Chicago. It smashed through the garage roof, shown above, penetrated the top of an automobile, and made a hole in the front seat cushion, to which Geology Curator Henry W. Nichols is pointing. The stone fell with a roar resembling that of a diving airplane.

there's a fourth dimension—time. We're not only somewhere, but some-when! And now Dr. Albert Einstein and some of his colleagues report they are investigating a fifth dimension.

How large is the Universe? Some astronomers think it may be infinite in size, with all the galaxies we see just tiny parts of a far larger supergalaxy, and so on forever.

If the Universe *is* expanding, however, it must have definite boundaries, astronomers say. Then what lies beyond? Nothing, not even space! But can space have boundaries? Yes, if space is curved, as Dr. Einstein says.

In curved space, you could look straight forward and see the back of your own head, if your eyes had sufficient power. This is because a ray of light, in curved space, would follow a curved path back to its starting point. So light reflected from the back of your head would travel on around curved space to your eyes, and you would see the back of your own head!

What of the future of the Universe? Since all the stars are radiating themselves away into space, some astronomers predict that eventually there will be no material substance left. It all will be turned into energy, they say, scattered afar. The Universe will have run down like an unwound clock. So far, we know of no way in which energy can be turned back into matter again; no way in which the Universe can be kept "wound up," though there may be such a process at work.

But of one thing we are sure. Through all the great Universe order prevails. The same natural laws that man has discovered in his laboratories govern every atom in the farthest, faintest galaxies.

"Man may be," says Dr. Harlow Shapley, of Harvard, "only the latest development of the whirling star mist, but the fact that he has intelligence enough to trace his own evolution stands unexplained, except by the presence in Nature of an intelligence far superior to his own."

AT HOME ON THE OCEANS

Whales and Sharks Make Exciting Neighbors for a Professor's Wife, Turned Able Seaman, On a Three-year Voyage Around the World

By Edith Bauer Strout

With Illustrations from Photographs by R. S. Strout and the Author

TRAVELING over the oceans in small boats is getting to be a habit for young men, but people still think it strange that a woman should enjoy such a cruise, except as a passenger.

Igdrasil carries no passengers, however, and when she sailed from Jacksonville, Florida, in June, 1934, I was, numerically at least, half of the crew. My husband, the other half, is listed as captain, while I am usually listed as seaman.

Though I may not fulfill all the requirements of an A.B. to "hand, reef, and steer," I do stand regular wheel watch, night as well as day. Sometimes I am listed as cook, but I usually object when the immigration officers want to list me as stewardess.

9,000 MILES FOR A VIEW

It all came about very suddenly. Many jokes have been made about the wife who insisted on the seashore when her husband wished to spend his vacation in the mountains. In our case it was just the reverse, for I came from Colorado and my husband from the coast of Maine. Instead of arguing the matter, we planned a vacation in far-off New Zealand, where sea and mountains meet in magnificent fiords hung with wind-blown waterfalls.

Since New Zealand's rugged southwest coast is practically uninhabited, we knew we must visit it in our own boat if we wished to see it thoroughly. So, to the astonishment of his associates, my husband resigned his assistant professorship at the Georgia School of Technology, Atlanta, and built a husky 37-foot craft suitable for ocean cruising (pages 34-36).

Though he had never built a boat before, the result was most satisfactory, for he is by no means the usual absent-minded professor. My small share in the construction was to putty some ten thousand nail holes!

Now, building a boat is much harder than sailing it; so, despite our lack of maritime experience, we started the long voyage from Jacksonville to Jamaica without any keen concern for what the future held in store (map, pages 38-39). The summer squalls of the Bahamas soon taught us all we needed to know about handling canvas.

BIRDS AND FISH ENLIVEN THE LONG WATCHES

To me, a landlubber, everything was new and exciting: the scream of protest from the long-tailed boatswain-birds as they hovered over us; the swift flight of the storm petrels, or Mother Carey's chickens, that followed in our wake, just touching the water with their feet as they picked up food shaken out of the sargasso seaweed by our hull; the boobies' curiosity in our spreading canvas; or the chattering of the terns when they found a school of small fish.

Then there were always the jellyfish, which to me seem like the flowers of the sea, with their many shapes and colors. With so much interesting life near by, how could I get lonely or bored, as so many people seem to expect?

Even in my night watches, I would sometimes be surprised by a porpoise blowing close by. This was always startling until I recognized the sound, and then I would watch intently while the porpoise wove a shining ribbon of phosphorescence as it played around the boat.

ABOARD THE "TREE OF LIFE"

At Jamaica the name of our sloop, *Igdrasil,* proved a stumbling block. No one could spell it, pronounce it, or remember it! This came as a shock to us, for we had picked the name deliberately as one that was easy to spell and pronounce, and appropriate in meaning.

Igdrasil is the Tree of Life in Norse mythology, the roots running down into hell while the branches reach up to heaven. Life on a small boat is just like that, sometimes pleasant, sometimes not. Also, the end of the world comes when the tree Ig-

TRANSIT AND GAUGE CHART A STRAIGHT WATERLINE FOR "IGDRASIL"

Mr. Strout marks the hull accurately, guided by H. O. Bumann, engineer, who sights through the instrument. When the boat is launched the line will meet the water uniformly all around the hull. The author's part in building the little yacht was to putty some ten thousand nail holes.

drasil falls. If our *Igdrasil* goes on the rocks, it will probably be the end of our world, too.

Mountainous Jamaica seemed a perfect paradise to me. It was my first tropical island and my first port after that trying voyage of calms and squalls. I appreciated a rest and was glad to get some fresh fruit. But no one lingers long in Jamaica in late July, and we certainly were not out looking for hurricanes, so we soon up-anchored and sailed across the high trade wind seas of the Caribbean for Panama (see Atlantic Map Supplement).

It is very nice to make a strange port in the daylight, but small sailboats are unable to know the exact time of arrival and we always enter when we arrive. Frequently the best view of a city from seaward is during the night, and Cristóbal looked dressed for a carnival. There were colored lights of several hues, both fixed and flashing, occulting lights and revolving lights—a grand display. But this was no festive mood, just the usual maze of navigational lights that help guide navigators through the Canal Zone.

I was a little frightened about the trip through the locks, but the water came in so gently that I did not notice when it started.

Everything in the Zone is built on such a uniformly huge scale that nothing appears big. Forty feet seems high when talking about it, but as our mast is that tall, and reached to the top of the walls, we did not have the feeling of being in a huge pit, as I had expected (page 37).

BLACK SQUALLS, A DOZEN A DAY

We saw the Canal Zone during the rainy season. Consequently we had no regrets when we left for sunnier days in the Galápagos Islands.

The Gulf of Panama, through which we now sailed, has a bad reputation for weather. Black arch squalls can have a fascination all their own, but when they come a dozen a day they are not wel-

come to a sailing vessel.

It was, of course, physically impossible for my husband to reef and set the big wet mainsail that many times a day, so we usually trusted to our ability to "luff them out." In such weather this is a dangerous procedure, but the boat was stoutly built and her gear was new and strong, so no damage resulted. Though there were many exciting moments under those great black arches, we suffered most from lack of sleep and the seemingly interminable rain which fell in torrents more than half of the time.

But all things end, and suddenly we emerged from the rain and mist to get our first view of the "Enchanted Isles," much higher on the horizon than they should have been, because of unusual refraction. Though they looked only five miles away, we sailed many times that distance before we reached them.

SEAMAN STROUT ALSO RATES THE TITLE OF COOK

She welcomed such a listing by immigration officials. Only when inspectors described her as "stewardess" of *Igdrasil* did she balk (p. 33). This galley, equipped with stove, sink, and table, is larger than usual for a 37-foot craft.

PRINTS OF HIGH-HEELED SHOES, EVEN IN THE "LONELY" GALÁPAGOS

Accounts of the Galápagos Islands had led us to believe they were desolate and barren. Barren they are, but, out of fifteen anchorages, at only one did we find no trace of previous human visitation.

At Marchena, or Bindloe, we found an Ecuadorian fishing boat catching a species of rock cod. We saw several tracks of human footprints, one of them a pair of high-heeled shoes, leading to the salt pond in James Bay on San Salvador Island; at Sulivan Bay there were fresh footprints before us as we climbed the loose lava of Bartholomew Island. While we were here an American yacht and the Ecuadorians came in, making three boats in Sulivan Bay (page 40). It seemed really crowded.

The anchorage between Santa Cruz (Indefatigable) and Seymour Islands is seldom visited and we found the mockingbirds not only friendly but willing to learn new tunes. Even this anchorage we could not

FLOATING RAFTS OF WATER HYACINTHS CLOSE IN ON "IGDRASIL"

Ready for departure on her world cruise, the craft lies in the St. Johns River off Jacksonville, Florida, 20 miles from the Atlantic. The sluggish stream, three miles wide here, is choked with the orchidlike plants which cover it like a sheet of bright lavender.

have alone with the mantas and sharks, for the fishing boat soon followed us and anchored for a night.

Santa Fé (Barrington Island) is a favorite rendezvous for fishermen drying their fish, and there were many evidences of frequent visits.

We spent Christmas on Santa Cruz Island with the settlers at Academy Bay. Even that much-attempted climb to the top of Indefatigable had been accomplished before, though I believe I was the first woman to reach the crater's rim. From the right direction it is an easy trip.

At Post Office Bay on Santa María we found letters left by a sailing ship which had called just before us (page 44). There was also evidence of a thoughtless visitor who had used oil drums for rifle targets, rendering them useless for catching precious rainwater.

In Tagus Cove, Isabela Island, besides the names of previous visiting yachts painted on the rock walls, there were good footpaths to the rim of the salt pond and cast-off clothing, some of it feminine, along the trails.

But at Elizabeth Bay in Penguin Cove we found no evidence of anyone having been there before. We were indeed alone to enjoy the scenery and the wild life. In the mangrove swamp the sea lions objected feebly to our encroachment as they slid off huge tree roots, while the marine iguanas hardly moved from their sunny spot at our approach (page 43). Even the big green turtles wouldn't swim off until we hit them with an oar.

WHALES TOO CLOSE FOR COMFORT

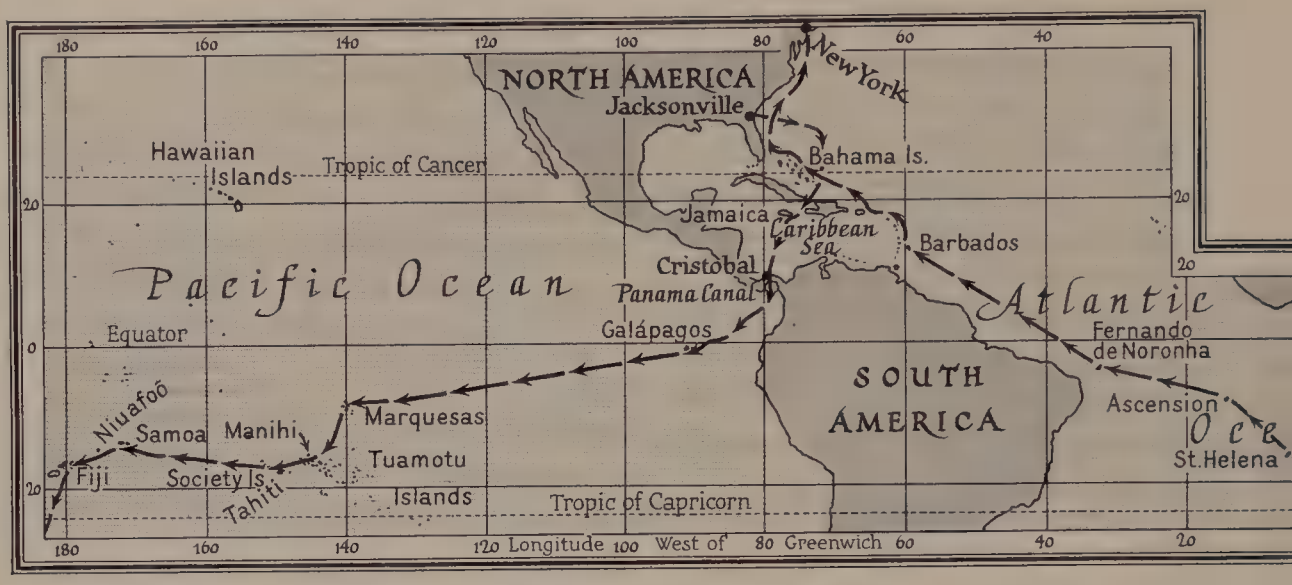
Unable to get drinking water, we were forced to leave these delightful islands when our supply was reduced to thirty gallons, for the next place of supply was the Marquesas Islands, 3,300 miles to the westward.*

With the steady winds in this section, the trip was apt to get tiresome. There were moments of excitement, however, as when

* All distances are given in statute miles.

LIKE AN OVERSIZED BARNACLE, "IGDRASIL" CLINGS TO A CANAL TUG

U. S. S. *Favorite,* used by the Panama Canal Commission, dwarfs the small yacht as together they make the downward trip through one of the locks. On the upward journey the craft was controlled by lines from shore. Electric locomotives, called "mules" in honor of their stubborn predecessors on the towpaths, pull ships through the locks. One "mule" appears just above the top of *Igdrasil's* mast.



IN A HOME-BUILT SLOOP, A PROFESSOR AND HIS WIFE GIRDLE THE GLOBE

Aboard the *Igdrasil,* 37 feet overall, 14 feet beam, 5 feet draft, the author and her husband sailed from Jacksonville, Florida, in June, 1934, bound for the New Zealand Sounds. After passing through the Panama Canal, they visited the Galápagos Islands, and then pushed into the South Sea. After a pleasant cruise, enlivened by stops at remote islands, they gained their destination on the southwest coast of South Island. Then the travelers took the longest way home. They crossed the Indian Ocean, rounded the Cape of Good Hope, and scudded up the Atlantic before the trades. When they reached the United States they had been away for three years and had cruised 38,000 miles.

two finback whales came up astern. They would swim languidly along ten feet from the transom, looking us over carefully, then pass deliberately three feet to one side of the boat, smothering us with the vile odor and vapor of their blowing (page 45).

One whale touched the boat the first time they passed and did not like it; so with a mighty heave he sent the boat in one direction while he departed on the opposite course! The other one played tag with us for an hour, coming so close at times that we could easily have jumped on his back, so we got to know him quite well. He showed scars on his skin where former travelers had used him for a rifle target.

Not caring for the foul smell of his exhaust, we were glad when he decided to depart.

Neither did I enjoy having the wheel spun out of my hand when a large blackfish hit the rudder during one of my watches. While it is delightful to watch the graceful motions of the porpoises and blackfish as they leap in the air, turning about and landing with a loud splash on their backs, it is disconcerting to have so heavy a fish jumping so close (pages 46 and 48).

A porpoise once hit the rail of our boat and we could not help thinking of the damage one would do if it landed on deck!

Meanwhile, the wind was pushing us along at a steady clip and before our drinking water was dangerously low we reached the Marquesas.

The native women were invariably excited when they learned there was a woman on board the *Igdrasil,* since small boats visiting the islands usually have only men aboard. On the larger yachts they had seen American women in purely decorative roles and generally wearing fancy pajamas. They had come to regard these as standard apparel in "Meniki," as they call our homeland, and so were very surprised when I came ashore in dresses.

Like all women, however, they were interested in the style of clothes and frequently I saw them indicating to one another how a collar or skirt was made.

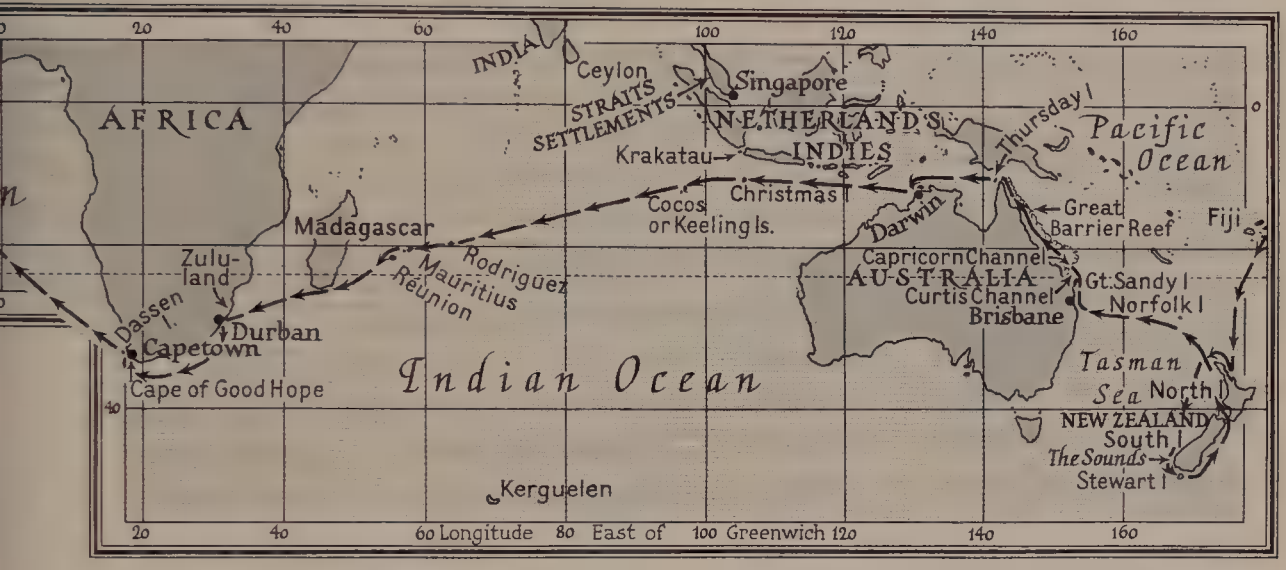
THERE'S MANY A SWEET TOOTH IN THE MARQUESAS

All the natives like sweets. At Tahuata Island, wishing to repay some kindnesses the natives had shown us, I sent ashore some doughnuts. These created a great stir, but as usual were passed out to the children, and when I came ashore later there was a little boy asleep on the *paepae* (the stone platform on which the native house is built) with his small fingers through the hole of a doughnut!

As the natives are so fond of children, anything special in the way of food is given to them at once. At Hanaïapa on Hiva-Oa

Island I took some fudge ashore for one of the chiefs, but instead of eating it or keeping it for his own family, he passed it all out to the children.

It was the first time they had met chocolate, apparently, for they didn't know what



to do with it. After a sign that it was to be eaten, a child tentatively licked a piece; then, as realization came, a broad smile flashed across his face.

At Hana Nai Bay, on Ua-Huka, I made a frosted cake for the chief. As he lived at another bay two miles away, we had to wait for someone to take it over. The owner of the valley put the cake under lock and key and went into great detail to the messenger on how to carry this valuable gift to the chief. Baked food is very rare here, even bread being available only where there is a Chinese to bake it.

The Marquesans are extremely courteous and most appreciative of any courtesies shown them. At Taipi-Vaï (Typee) on Nuku-Hiva we called on Haka Hau, the last of the Taipis. A very old man now, he was confined to his bed, but he retained the bearing of a gentleman, and his speech was pleasant in a language normally harsh, to my ear.

THE "COCONUT TELEGRAPH"

After a walk up the valley, on our return we found his wife waiting for us with drinking nuts and a large basket of papayas. This showed real thought in a gift, as the natives do not eat papayas. There are few growing in the valley, but, knowing that Americans like them, Haka Hau's wife had managed to collect them for us.

One day I saw Taupu, wife of a trader, weaving with pandanus. I liked the design of the basket and asked her to show me how to weave one. Taupu spoke French and Marquesan, while I spoke only English, but the basket was soon started. All the women of the village knew the moment I finished it, by that wonderful word-of-mouth relay system, the "coconut telegraph."

Taupu was so delighted that a white woman should be interested in her handiwork that she gave me a fine vakini palm hat which had taken her at least a week to weave (page 53).

We took long walks on all the islands, sometimes visiting a lofty waterfall at the head of a valley. Few people make the short trip up to the falls and the village where Herman Melville lived, not so much because of the heat as because of sand flies. But if one keeps on the move they don't bother too much.

Going inland, we were always taken to see *tiki*, the large stone gods which adorned the natives' old sacred places. These shrines were tabu for women, and even now few native women will go near them (page 49). Going to visit one at Tai Oa Bay, I fell from a loose rock and scraped the skin off my nose. A murmur arose among the native men: "Devil strong today."

Most tropical fruits are plentiful in the Marquesas, and our diet was quite varied. Eggs, however, are difficult to obtain. The natives consider only the final result, a nice chicken to eat, and so let nature take its course.

At Haka Hetau, on Ua-Pu, the natives took a liking to our large forged salt water fishhooks, and offered a chicken or a dozen eggs for three fishhooks. We wanted eggs,

A RUINED CASTLE IN THE GALÁPAGOS? NO—A LAVA PINNACLE WIND-ETCHED WITH SAND

Mrs. Strout inspects a tree cactus rising from volcanic soil near Sulivan Bay, on San Salvador (James) Island. Thousands of wild donkeys have trod a complicated network of trails across its surface. In the seventeenth century the island was the rendezvous of buccaneers, who named it in honor of James I of England.

Photograph by George E. Stone

FLIGHTLESS CORMORANTS OF GALÁPAGOS ISLANDS SHOW NO FEAR OF HUMAN INTRUDERS

Since seafood is abundant and enemies few, the cormorants have little occasion to fly. Over the centuries their wings have become stunted until now they are virtually useless. Here in a rookery at Tagus Cove, Isabela (Albemarle) Island, they permitted the visitor to approach within two or three feet before they waddled away.

IF WALLS COULD SPEAK, WOULD THESE DISCLOSE THE MYSTERY OF "THE BARONESS OF THE GALÁPAGOS?"

The author (right) chats with Mrs. Wittmer who, with her husband and two boys, settled on Santa María, or Charles Island, in 1931; they are now its sole residents. They were preceded by the German Dr. Friedrich Ritter and Frau Dore Koerwin, seekers of an idyllic tropical existence. Quiet of the island was disturbed later with the coming of the Baroness Eloise de Wagner Wehrborn and two men companions. Constant scenes of turbulence came to a climax in March, 1934, when the Baroness and one of her friends suddenly vanished. Alfred Lorenz, the other companion, said they sailed away in a boat. They have not been seen since. Lorenz perished later of thirst and hunger on an island to the north. Dr. Ritter died and Frau Koerwin returned to Germany.

so all the children in the village started following the hens, waiting for them to lay. As soon as they had collected four eggs, they brought them out, still warm, to get their fishhook.

WHITE "CANNIBALS" INSPIRE FEAR

Instead of the admonition that "the policeman will get you," the Marquesans vary it for their children by telling them that "the white man will get you." At Haka Hetau we took the big camera ashore to make pictures of the pinnacles which grace this lovely island, and, while we were waiting for the clouds to lift, the older boys started teasing their younger brothers by telling them that we would cut them up, pack them in the camera case, and take them back to America. This started the children crying and off they ran.

I tried to quiet a little girl one day by giving her a doughnut. Curiosity overcame her fear for a while, but when I tried to explain by signs that the doughnut was good to eat, the child thought I was going to eat *her*, and so became more frightened than before!

Throughout the islands we had heard through the coconut telegraph that the "man who knew the war business fine" wished us to stop and visit with him. The natives' description aroused our curiosity. Stopping at Hikeu Bay, we found living there an American ex-Navy enlisted man who welcomed fellow countrymen and appreciated news of home.

Sailing on, we reached Manihi in the Tuamotus, which I shall always remember for the politeness of its citizens. The natives had asked to come aboard to see the boat. While they were on board, my bread had risen and was ready for the oven, so I started the fire. Instantly everyone, even the children, left. To them the fire meant cooking and if they stayed I would have to offer them some of the food to be polite. To stay, they believed, would be begging.

TWO SUSPICIOUS SEA IGUANAS SCRAMBLE ASHORE AS THE AUTHOR APPROACHES

Though alarmed as Mrs. Strout visits them on Isabela (Albemarle) Island, they will not retreat inland, for they always stay close to the water. Galápagos iguanas are the only lizards in the world that live in the sea. When they swim they keep their legs tight against their sides and propel themselves by snakelike wriggles of tails and bodies. Only their heads are visible above water. Charles Darwin described these strange creatures a century ago.

Though we remained only a few hours, we left with gifts of shell, coconuts, and chickens, while the natives enjoyed our large mangoes.

With the Tuamotus behind us we encountered the sudden change in weather characteristic of this region. The trades were fickle and sometimes a dozen small rain squalls would be in sight at once. This meant slow progress and hard work for my husband handling canvas. To make matters worse in the calms, a long heavy swell was rolling up from some disturbance in the far south.

We stopped at Tahiti only long enough to collect mail, then left for Mooréa and the beautiful Leeward group of the Society Islands. The largest of these, Raïatea, presented a rugged outline from the sea and the native thatch-roofed villages looked most attractive as we coasted along the edge of the reef. But close inspection detracted so much from the beauty of the houses that we soon left for Bora-Bora, a tiny island consisting entirely of one massive mountain encircled by a narrow and comparatively level strip of land upon which the inhabitants live.

The southeast trade winds are supposed to blow between Bora-Bora and Samoa, but we had days of calm which for once we appreciated, since they gave us a chance to recover from serious colds contracted in Bora-Bora.

A BLOW IN THE DARK

After the calms came first a southwest and then a southeast gale. During one of these howling black nights, while intently watching the compass and trying to keep the rain from running down my neck, I received a sudden hard blow on my arm.

A shout from me brought "the captain" on deck to start investigations. The flashlight disclosed a large flying fish, dead of a broken vertebra! Laughable when it was all over, but I don't delight in hard blows from some unseen foe.

There is always a fascination about entering a strange port at night. We have put into many in the dark, but of them all Pago Pago Harbor will be remembered

LOOKING FOR WESTBOUND MAIL IN THE BARREL POST OFFICE

Craft calling irregularly in the Galápagos collect letters left in the crude "mail box." Usually few are found. On this occasion Mrs. Strout discovered two handfuls because a sailing ship had passed a few days before and the crew had deposited letters. *Igdrasil* picked up the mail addressed to places on her course.

longest. I am not a lover of corrugated-iron roofs, but here they were objects of beauty, as their aluminum-painted surfaces reflected the moonlight, diamondlike, while the dark-green background took on a velvety appearance.

Generations of tribal customs have bred in the Samoans an attitude of community ownership, which, naturally enough, sometimes clashed with our viewpoint. They would swarm aboard the boat, never thinking to ask permission first, and stay indefinitely. When we went ashore, they would frequently borrow our dinghy to row out and look the boat over. This was in marked contrast to the other Polynesian islands we had visited, where the natives made a detour around the boat when we were not aboard.

In American Samoa the native has been encouraged to retain his customs and arts, but contact with civilization makes some startling contrasts. We watched a wedding procession one day. The bride was dressed in a white satin gown with long sleeves and a long white tulle veil held up by two little flower girls, also in white satin. All the bridesmaids were dressed in white. The clothes would have looked appropriate in any American town, but not one of the girls wore shoes!

We were anchored off the *malae,* the market place of the Station, and could watch at leisure as the natives arrived on steamer days to display their goods. They came in long boats pulling anything up to thirty oars, and always with some small child in the bow setting the stroke by drumming on an oil tin (page 52).

WATER'S FINE, BUT NOT THE SHARKS!

After we left Apia, the trade winds failed us again and for three days we drifted about in calms and light airs with Savaii in sight to the northwest.

During the blistering heat of these calms, the water alongside looked tempting for a

"OH, FOR A SAIL!" CRIES THE "MAROONED" SKIPPER

Mr. Strout could not resist playing Robinson Crusoe when he saw this sentinel palm overlooking the sea on a rocky islet off the southwestern side of Moala. This island is one of the small outposts of the Fiji Archipelago in the South Sea.

A WHALE WITH HALITOSIS COMES TOO CLOSE FOR COMFORT!

Playing tag with *Igdrasil* for an hour, as the craft headed for the Marquesas, the monster came so close the author could have leaped on its back. When alongside it blew lustily, almost smothering Mr. and Mrs. Strout with vile vapor. The whale's companion touched the boat the first time it swam by. Becoming displeased, it pushed the yacht away with a mighty heave (page 38).

"WALKING ON ITS TAIL," A PORPOISE TURNS FLIP-FLOP IN THE AIR

These playful, bottlenosed fellows, some of them 12 feet long, swarmed about *Igdrasil* as she headed into the South Pacific. Often these mammals weigh up to 400 pounds. The foam at lower left is the wake of the yacht.

TAKING OFF ON A FULL STOMACH IS TOO MUCH FOR THIS ALBATROSS

After gorging itself, the bird tries vainly to fly away as the yacht pursues it in a stretch of the South Sea. Clumsily the big fellow bounces over the water. Even with its great wing spread, it could not sail aloft until it had disgorged its dinner.

swim, but the sharks were too numerous. Other small-boat travelers have gone over the side for a daily swim and lived to tell about it, but we saw too many sharks, in the South Pacific at least, to tempt me to follow their example.

Sometimes at night a shimmering blob of phosphorescence fifty feet astern showed where a lone hunter followed us, patiently waiting. It always gave me an eerie feeling.

At other times half a dozen ten- or twelve-foot brutes would play around, just under the transom. Sometimes they would try to rub off parasites by scraping along the bilge of the boat, much to the detriment of the bottom paint. Then my husband would shoot them at a range of three feet with the .45-caliber service pistol. Though they often sank, trailing blood and mortally wounded, the others did not attack them.

THE HELMSMAN TAKES IT EASY ON A GLASSY SEA

During light weather on the cruise to New Zealand, even the tortoises in their pen behind the wheel find sailing smooth. These pets were acquired in the Galápagos. To the right of the author a piece of canvas protects the diaphragm bilge pump, fortunately not needed on the voyage.

These memories are too vivid for me to wish to swim offshore in the open ocean.

Finally the wind came and we bore away for Niuafoō, so-called "Tin Can Island," expecting to make it the next morning. But the wind freshened steadily and by midnight a slightly denser blob of shadow in the general darkness ahead told us that we were almost on top of the island. We had to change course to avoid it.

The landfall did not come as a surprise, for we had been smelling the island for hours. It was smoke that we smelled, but whether from fires or from the volcano on the island we could not tell.*

In Fiji I again fell back on candy for trade goods with the children. I wanted some sea shells, and soon found that their quick eyes could find them better than mine. They brought me all I wanted.

We had difficulty in obtaining food at any of the islands in the Fiji group until we hit upon the particular thing the natives

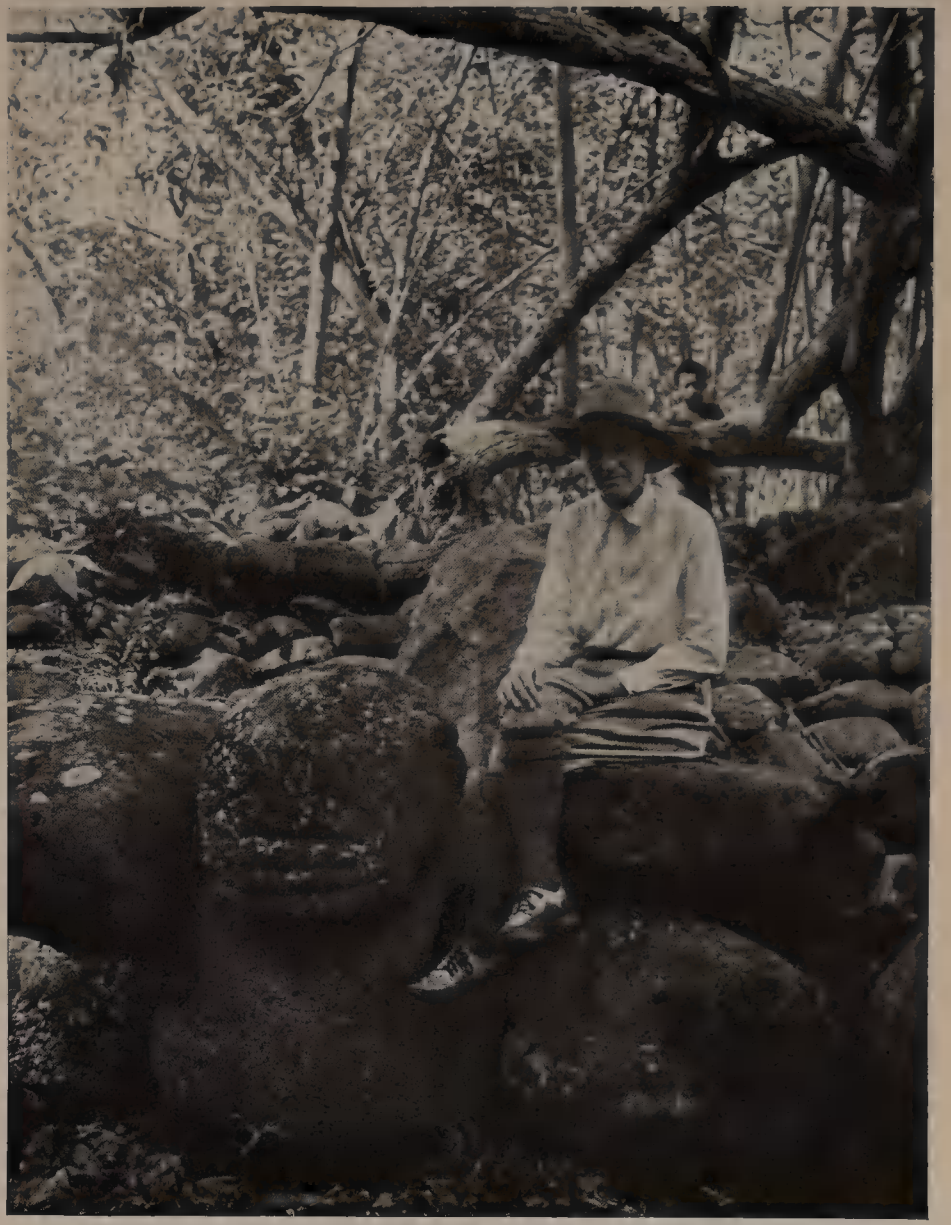
* See "Living on a Volcano," by Thomas A. Jaggar, National Geographic Magazine, July, 1935.

BIG BLACKFISH ROMP ABOUT "IGDRASIL" AS SHE CRUISES THROUGH SOUTHERN WATERS

One of the sportive mammals once hit the rudder with terrific force while the author was on watch in the South Pacific. The wheel spun around, knocking her hand away (page 38). Blackfish sometimes attain a length of 28 feet and weigh as much as one and a half tons.

MARQUESANS ASKED FOR PICTURES OF THEIR CHILDREN

Photographs replaced the old-time beads and trinkets as a medium of barter. Parental affection was marked. When the author gave a Hanaïapa chief some fudge, he immediately passed it all out to grinning youngsters (page 38).



MRS. STROUT LINGERS IN MELVILLE'S VALE OF "TYPEE"

An old stone god conjures memories of the author of *Moby Dick,* who dwelt in this paradise on Nuku-Hiva. The American writer described in *Typee* his life in the jungle Eden with cannibal captors and the lovely Fayaway.

POOR SHRIMPS CAN'T RESIST HER!

Netting fresh-water shrimps is a specialty of this Marquesan beauty. When asked to pose, she hurriedly let her hair down.

wanted most. At Ngau they wanted their photographs, and brought us all the food we needed. We could always get food with pictures, but because of the limited water supply carried and the amount needed for developing and printing, we preferred other means of barter.

NATIVES PRIZE THE "GEOGRAPHIC"

At Moala the natives all wanted to learn English and magazines were highly prized, worth more than money, particularly the NATIONAL GEOGRAPHIC because of its illustrations in color.

At Matuku we tried for a week to purchase bananas, but without avail until I showed some women a velvet jacket. It appeared to be the first velvet they had ever seen. When word was circulated that we had *women's* clothes for trade, more than 800 pounds of fruit and vegetables were loaded on board before 8 o'clock the next morning!

Here in Fiji the natives varied the usual question and, instead of asking if we were married, they asked if I were Mr. Strout's sister. This puzzled us until we discovered that the Fijian girls of my size were much below marriageable age. Just as child marriages in India shock us, I suspect we shocked the Fijians!

In October we left for New Zealand, with "Mothe" (sleep), the Fijian good-by, coming again and again from the tree-covered hills.

One of New Zealand's frequent barometric depressions greeted us as we approached the Dominion* and for some hours we lay hove to under the close-reefed mainsail. It blew so hard it seemed likely that the sail, now getting old, might blow out and a sea anchor was made ready to meet that possible contingency. But the many weary hours spent with palm (the sailor's "thimble") and needle in Fiji paid good dividends here, for nothing let go.

*See "New Zealand 'Down Under,'" by W. Robert Moore, NATIONAL GEOGRAPHIC MAGAZINE, February, 1936.

The weather was still thick when we made a landfall on Cape Brett, but soon, between the rain squalls, we could make out sheep farms which, from a distance at sea, looked like well-kept lawns of country estates.

We were now within seven hundred miles, air line, of the objective of our whole cruise, the west coast Sounds, which we had sailed more than a third of the way around the world to see.

Located on the southwest coast of the South Island of New Zealand, the Sounds, or fiords, were carved out of the Southern Alps partly by previous glaciers. Narrow, winding ribbons of water between very steep and high mountains, they vary from a half to two miles wide and sometimes extend inland for twenty miles.

A hundred and sixty-odd years ago Captain Cook, finding in Dusky Sound what he considered good harbors and a thick stand of trees "suitable for masts," prophesied that it would become the site of a large and thriving city. But the boisterous weather and exceedingly rocky and mountainous country all around have defied attempts at settlement, and one finds the Sounds today almost as peaceful and uninhabited as when first discovered. As the excursion steamers stop only for a few hours at Milford Sound, it is necessary to go in your own vessel if you wish to see the other twelve Sounds thoroughly.

IN THE "ROARING FORTIES"

Being so near our goal, we begrudged the time necessarily spent in Auckland making a new suit of sails and changing the rig of the boat from sloop to ketch. The ketch rig, however, made the boat easier to handle in the more boisterous weather of the "roaring forties" (page 60).

As the season advanced and our impatience increased, we decided to go the shortest but roughest route and headed north out of Auckland to round North Cape and sail directly down the Tasman Sea to the Sounds (map, pages 38-39).

We stopped at the Bay of Islands, for this bay of smooth waterways is too tempting for any yachtsman to pass. We left it by moonlight which silvered the scene as we glided silently along this bold coast.

After a short stop at Whangaroa, with its fantastic rock formations, we had a look into the arm where, 130 years ago, the British ship *Boyd* was burned.

Sailing on toward North Cape, we wondered whether we should meet with the same bad luck that befell Captain Cook when he was rounding this rocky point. Head winds, calms, and currents delayed him for ten days.

A FULL-RIGGED GHOST OF THE PAST

As we neared North Cape, our attention was attracted to what I at first thought was a large off-lying rock. Actually we soon made it out as a ship under full sail (page 62). We passed her off Parengarenga Harbour at sunset and she proved to be the ship *Joseph Conrad*.*

All of her crew were lined up on the forecastle to look us over. Apparently a small vessel flying the American flag was as strange to them off these sand dunes as they were to us. My dream of passing a full-rigged ship at sea was at last realized.

Cape Maria Van Diemen, the northwestern point of New Zealand, had the appearance of having been just newly finished by the Creator, and though some might call it barren, to us it was beautiful. Here, however, we felt the full surge of the long southwest swell of the Tasman, as we were out of the lee of New Zealand.

We shaped our course for Milford Sound, running the length of the Tasman with the usual summer weather while the barometer fluctuated from high to low in quick succession. After a hard southeast gale, which, being an offshore wind, blows the clouds to sea, we got our first glimpse of the Southern Alps, sighting Mount Aspiring and Pembroke Peak, the landfall for Milford Sound.

WATERFALLS THAT BLOW AWAY

It was night when we finally made the entrance to Milford Sound, and cautiously felt our way into Anita Bay. As in most of the anchorages in the Sounds, the bottom slopes so steeply that an anchor will not hold with offshore winds. Since any possible anchorage depth is very near the shore, a hook is dropped, then a line from the stern is made fast to a rock or large tree (page 64). By the time our anchor touched bottom we seemed directly under the trees and within jumping distance of the rocks.

In the morning fog came rolling rapidly in from the sea and soon a nasty squall shut off everything from view. Naturally

* See "North About," by Alan J. Villiers, in the National Geographic Magazine, February, 1937.

DRUMMING ON A CAN, A SMALL BOY IN THE BOW SETS THE STROKE

Samoan longboats are copied after the trim craft which carried landing parties from British ships to the islands, nearly a century ago.

MAN'S PLACE IS IN THE KITCHEN IN THE MARQUESAS

Husbands do most of the cooking. The islander at right pounds roasted breadfruit spread on the board before him with a stone pestle. He dips his left hand into a bucket for water to moisten the mixture. His helper is peeling an additional supply. Breadfruit is eaten as a pasty mass. At least thirty-two varieties of this staff of life grow on the islands.

we wanted fine weather for seeing the mountains, but the spectacle of rugged peaks coming out of the clouds was well worth viewing. Besides, the high hillsides suddenly blossomed out with waterfalls all over. The mountainsides are so steep that during rains many high ribbons of water fall directly into the sea. Some of the high ones never meet the sea, for the strong wind blows the water away into mist before it reaches the foot.

The Sounds are as famous for their bad weather as they are for their beauty, and we had both a southeast and a northwest gale during the short time we were in Milford.

But in any of the Sounds a gale, besides causing extra work in putting out more lines ashore to moor the boat securely, is a beautiful sight. The wind sweeps over some high mountain, hits the high walls of another on the far side of the sound, and swirls down into the cove, lifting the surface of the water in great white sheets and throwing it around the landscape.

TAUPU MUST WEAVE FOR A WEEK TO MAKE A FINE HAT

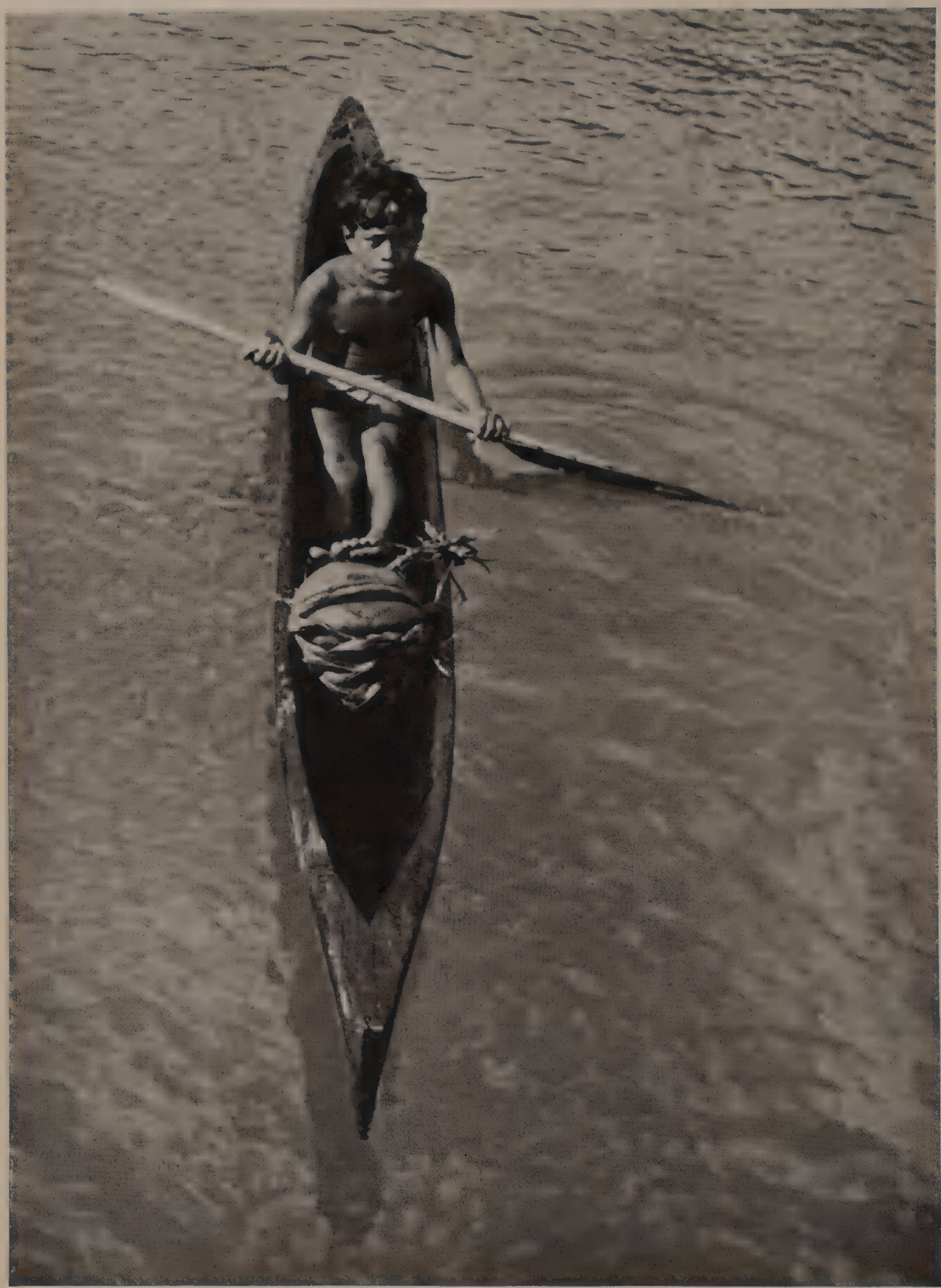
The author, impressed by the skill of this Marquesan woman, asked to learn the art. So pleased was the weaver that she gave Mrs. Strout her masterpiece as a present (page 39). Islanders seldom sit cross-legged, preferring to stretch out comfortably on the floor.

Waterfalls are blown from their regular drop, causing the hillsides to sparkle as the sun shines on the spray. If rain accompanies the gale, it is a game to see who can find the most new waterfalls.

Weather conditions along this coast were such that it was best for us to leave the Sounds during the night, and arrive off the entrance to the next one in the early morning. Offhand, it would seem wrong to go down such a beautiful coast at night, but the mountains show up clearly in the moonlight, which lays a new and different emphasis upon each glacier, ridge, and valley.

At Charles Sound we noticed that the trees at the entrance all grew inward toward the land, testifying to the force and constancy of the wind along this coast.

We were thankful for the fine weather as we anchored in Daggs Sound, remembering that in 1851 Commander G. H. Richards, of the British naval survey vessel *Acheron,*



"NEED ANY PAPAYAS TODAY?"

Serious mien changed to broad smile when the lad disposed of his basket of tropical fruit to the yacht. He received a biscuit tin and some candy in payment and paddled rapidly back to the village. He tramped down the main street, drumming on the tin, while his envious playfellows trooped after him. Ancestors of this Bora-Bora Island boy traded in this manner with Captain Cook.

had recorded here "a remarkable scene."

"Our anchorage," he wrote, "was at the head of the northern arm, 200 yards from shore, in 12 fathoms; the change of the moon brought a northwest gale, with heavy rain, and in the course of a few hours no less than 14 magnificent cascades were pouring down the steep sides of the mountains (upwards of 3,000 feet high), by which we were surrounded, bringing with them trees of considerable size and all other obstructions met with in their passage.

"The effect was as if a heavy surf was breaking round the vessel; the mist, floating as low as our mastheads, occasionally obscured everything but the summits of the mountains and the foam below, and produced altogether a scene as grand as it is possible to conceive, which lasted without abating in any degree for two days, when the water alongside, which had been as salt as the ocean, was for a considerable depth below the surface perfectly fresh."

MAP IS DOTTED WITH GRAPHIC NAMES

One look at the names on the chart and you know Captain Cook passed this way. There are Dusky Sound, Anchor Island, Facile Harbour, Duck Cove, Luncheon Cove, Supper Cove, Nine Fathom Passage, Cascade Cove, Wet Jacket Arm, Beach Harbour, Breaksea Island, Broke-adrift Passage, Cast-off Point, Towing Head, and so on indefinitely.

All over New Zealand, but particularly around the southern Sounds, the names are descriptive of the character of the mountains or sea, or of incidents of their exploration. It takes little imagination to reconstruct the path of the early navigators and what they found, even without their journals as a guide. And what delight just to read the names on the map, even if one cannot visit the places!

We passed Breaksea Island on such a calm day that it did not deserve its name, then proceeded up Breaksea Sound. Only the wake of our small craft, and the occasional flight of wild ducks or black swans, broke the surface of the still waters. Next day we went through the passage that connects Breaksea and Dusky Sounds. By using our small auxiliary motor we made in five hours a trip which took Captain Cook in the *Resolution* eight days under sail and tow.

At Pickersgill Harbour in Dusky Sound we saw many fish, nice fat blue cod, swimming lazily among the kelp, though we didn't want a couple of boats full, as had some of the early explorers.

SAND FLIES WORSE THAN "FIFTY ANIMAL"

As for the sand flies, the description given by a member of Vancouver's expedition is still accurate:

> A sand fly annoy'd us more than perhaps fifty animal wou'd, for no sooner did we set our feet on shore than we were covered with these flys, and their sting is as painful as that of a Musquitto, and made us scratch as if we had got the itch; indeed, one of my legs became so much swell'd by this means that I was forced to apply a poultice to it, and was lame for two or three days.

Knowing about them in advance, we suffered no casualties, though we were glad to be on the water instead of camping.

Since the weather was getting worse, we took the *Igdrasil* into a very small nook on the west side of Crayfish Island. The anchorages in these Sounds are so few that one gets into some rather astonishing places. Here we had rock walls on either side only ten feet away and but little more astern, while the opening faced into the main cove. Once we were securely tied in this snug little hole, the gale whistled overhead unheeded.

Leaving Dusky Sound, we soon picked up the blink of Puysegur Light on the low-lying clouds. All night we were able to see either the blink or the light itself and keep our bearings on it. It is the only light on this coast. What a consoling and cheerful sight it was to me as I realized that here at last were some people!

Balleny Reef was breaking heavily as we took the narrow passage between it and Gulches Head, off which there are many rocks. All along this coast the major points have off-lying pinnacles and spires on which the sea breaks heavily. To a person on shore it looks beautiful, but to a mariner it looks like a graveyard done in brown. Strangely, there have been comparatively few wrecks on this coast, perhaps because everyone who can keeps severely away.

We decided to drop in on the lonely keepers, and as no day watch is kept at the light, we were not seen as we entered Preservation Inlet. At the radio operator's residence we whistled CQ, the call to all stations.

"Come in," said a voice, and we entered.

The operator had thought it was one of his two fellow lighthouse keepers and was amazed to see two strangers walk in. For

FIJI ISLANDERS NOW GO TO CHURCH WHEN THE TRIBAL DRUMS SOUND

The resonant thump produced by beating the stick on the hollowed trunk carries far. Once it called the warriors to pagan rites, but today most of the inhabitants are Christians. Such drums are commonplace on most of the 250 islands in this South Sea group.

three months he had not seen a soul from the outside world.

At leisurely pace we made our way up the sound until it terminated abruptly at the foot of a waterfall. In this perfectly protected spot we listened to the ringing notes of the bellbird and the scolding of the fantail.

WEASELS TAKE TOLL OF BIRDS

Rowing into the bordering swamps, we could watch the young ducks swimming near by, see the pigeons flying overhead, and, if lucky, sight a weka, for this region is one of the last stands of the many native New Zealand birds. The flightless ones, particularly, are disappearing before the onslaughts of the weasel, imported to curb rodents.

In such a peaceful, quiet setting, who would believe that only twenty miles away, at the entrance to the sound, a hard gale was blowing? Only the swiftly moving clouds gave any indication of wind.

We were in the Sounds in late March, when it is cold in these latitudes, and the snow was creeping down on the hillsides. When we had frost on the sails twice and the snow was at times within a thousand feet of the water, we left our snug anchorage so far inland for a very wet and cold run through Foveaux Strait.

Of course we had seen albatrosses all along New Zealand, but around Stewart Island there were several species following the boat at all times. Like the South Sea islanders, who can't understand a boat that isn't trading, these albatrosses couldn't understand a boat that didn't dispense fish scraps. Even the species called the shy albatross would come close, expecting to be fed.

We spent a day at Oban, Stewart Island, and would have liked to linger in Paterson Inlet, but a spell of good weather at this time of the year was too tempting to a sailor, so we crossed the usually rough Foveaux Strait to Bluff. The town here is really Campbelltown, but sailors have always referred to the port as "The Bluff" because of its prominent landmark, so that now even letters bear that postmark.

The Bluff has a reputation for wind, and it demonstrated its claim to this before we left, blowing so hard that a 9,000-ton steamer at the same pier with us let go both

FIJI TOY BOATS PUT OUT TO SEA, NEVER TO RETURN

Hibiscus branches are the hulls, coconut fronds the sails. The frail craft, traveling with the wind, forge across the lagoon and away. Dark eyes watch intently until the canoes disappear.

anchors to bring up with, in case all her dock lines parted!

The coast from Bluff to Dunedin seemed as desolate and uninhabited as the west coast, for not once did we see any sign of human habitation other than two lighthouses. Winter was howling up from the southward, and as this was supposed to be a pleasure cruise, we were hurrying north. So we made short stops in Dunedin, Lyttelton, and Wellington, but such was the hospitality of these cities that we made many friends in each.

"LET'S GO ON AROUND THE WORLD"

This was the turning point of the voyage. For nearly two years the New Zealand Sounds had been before us as the objective of the cruise. Now they were behind and we had to come home. Which way should it be, back across the Pacific or around the Cape of Good Hope and up the Atlantic?

Though many thousands of miles longer, the latter route is probably the easier and pleasanter, so we continued on around the world.

My husband was somewhat reluctant to do this, for ever since the keel of the ship had been laid, newspaper reporters had annoyed him by writing of us as "round the world voyagers." To his logical mind circumnavigation ceased to be a legitimate objective for a cruise when Magellan proved it could be done. After that it was merely a trivial incident, which might occur with anyone in the course of more interesting activities.

Wellington got a first-class storm while we were there, making a sixty-year-record barometric low, but we hardly felt it, tucked away in the most protected spot the harbormaster could find for us. In the calm following this storm we passed through Cook Strait and started across the Tasman Sea for Brisbane.

The Tasman Sea lived up to its evil reputation by developing a cyclone west of Norfolk when we were heading for that island. We changed course to avoid it, but even so *Igdrasil* took quite a beating.

My usual wheel watch is three hours, though I have, in light weather, stayed at that post for as long as eight hours. Running in this storm, however, the steering was so hard as to be utterly beyond my strength. This put a greater load on my husband, who fought that bucking wheel continuously for thirteen hours on one

Photograph courtesy New Zealand Government

EVEN MAJESTIC MOUNT EGMONT DIMMED IN GRANDEUR AS "IGDRASIL," BECALMED, LAY WITHIN SIGHT FOR FIVE DAYS

Close to the western shore of North Island, New Zealand, the slumbering volcano towers 8,260 feet above the sea. Three other peaks rise farther inland. The lighthouse stands near one end of Cook Strait, which divides New Zealand into North and South Islands.

"IGDRASIL" FINDS A HAVEN AMONG ROCKY CUMBERLAND ISLANDS, WITHIN THE GREAT BARRIER REEF

After a rough passage from New Zealand, the Strouts welcomed this pleasant anchorage off the east coast of Australia. Branches of Moreton Bay pine trees, or hoop pines, wave a friendly greeting in the foreground. From this quiet bay the globe girdlers pushed northward, hugging the shoreline on the inner route to Darwin (page 62).

WITH SHEER-RISING MITRE PEAK AS A BACKDROP, "IGDRASIL" LIES AT ANCHOR IN FRESHWATER BASIN

Such tranquillity at the head of Milford Sound seldom lasts long, for heavy gales are frequent. The boat now is rigged as a ketch. The change, made during a stop at Auckland, permitted easier handling of the craft in the stormy weather that prevails along this part of the New Zealand coast (page 51).

Photograph courtesy New Zealand Government

GIANT PILES OF STONE PANCAKES ARE STACKED HIGH ALONG THE NEW ZEALAND COAST

Curious rock formations and caves stud the shore near Punakaiki, South Island. Near by, the sea rushes with great force into a famous blowhole between rocky barriers, sending up waterspouts that sometimes shoot spray 150 feet into the air.

UNDER FULL SAIL, "JOSEPH CONRAD" DRIFTS BY AGAINST THE SUNSET

Nearing North Cape, New Zealand, *Igdrasil* passed Alan Villiers' famous square-rigger on its voyage "North About." Sailors line up on the forecastle to watch the small yacht, just as interesting to them as their own full-rigged ship is to the Strouts (page 51). *Joseph Conrad,* built in 1882 in Copenhagen, no longer carries cargoes across the seas. Her last owner, Huntington Hartford, gave the vessel to the United States Maritime Commission to be used as a training ship for the merchant marine. Her home berth is a Staten Island Coast Guard pier in New York Bay.

occasion before heaving to for a rest.

Two knockdowns resulted from this hard driving under close-reefed main and forestaysail. They scared me thoroughly, but did no damage to the ship.

Looking back on the experience now, I am not sure which bothered us the more, the storm or the ten-day calm that followed it!

We spent some time in the spreading city of Brisbane before heading north for warmer weather and the famous route inside the Great Barrier Reef (page 59). Though most strangers enter this route through the spacious Curtis or Capricorn Channels, we chose the winding strait inside of Great Sandy, or Frazer Island. The scenery is very similar to the salt-water creeks of Georgia where we built the boat.

Against the advice of the Brisbane yachtsmen, we sailed night and day at all times within the Barrier. This added interest to the trip and was perfectly safe, as the route is very well lighted. We stopped at a number of islands along the way, liking Thomas, with its snug anchorage and smooth beaches, best. Indeed, the beaches of these islands are their chief attraction, for the vegetation is mostly hoop pines and turkeybush.

The islands along this Queensland coast are almost entirely devoid of coconuts, that palm not being indigenous here. But visitors usually associate coconuts with the Tropics, so the vacation resorts always have some planted near by. This makes an

excellent label, for it advertises, even to the casual visitor like ourselves, which ones are resort islands.

At Thursday Island pearling is the major industry and the fleet of luggers employed in this service are splendid sailing vessels. They are manned mostly by aborigines, while the divers are indentured Japanese.

Though able boats, they are not too well kept and they look their best in the evening light. Then on each boat the rice and fish are cooked on deck over an open fire that throws its light on the glistening faces of the waiting blacks. If the boat has been at anchor long, the fish may have been caught on a trolling line carried out astern by the current. Trolling at anchor is not a joke at Thursday Island's harbor, with its strong currents.

We arrived at Darwin at the best time of the year, during the dry season, when the large areas of semi-swamp country have dried out, leaving only small ponds, or "billabongs." These are densely populated with wild ducks and geese, brolgas, or native companion birds, pelicans, egrets, plovers, and many others.

ANTHILLS RUN NORTH AND SOUTH

In northern Australia one frequently runs across giant anthills, but the most interesting to us were those near Darwin. Gray instead of the usual red, they are built like a flattened wedge, the narrow edge running north and south. This has earned them the name of "magnetic" ant hills. When seen broadside, they so closely resemble granite tombstones that one large field of them is called "Cemetery Park" (pages 64 and 65).

We left Darwin and Australia during the month of change from dry to wet seasons; so when we saw five waterspouts around us at one time we thought the rainy season was winning. But it was merely the trade wind trying to assert itself. Wind was what we wanted, and soon we were making good time toward Christmas Island.

With the boat moored securely to the phosphate company's buoys in Flying Fish Cove on this British island 15 days later, we were free to spend many hours ashore. Except for a visit to the phosphate quarry, our activities were mostly social, for there is but one short road and Christmas Island terrain resists exploration on foot (page 68).

About thirteen miles long and rising nearly 1,200 feet, the island is composed of uplifted limestone, extremely rough on the surface, and densely covered with trees and underbrush. Hiking, anywhere off the railroad, means constant work with the machete, so it is seldom attempted. The trails cut in the original exploration for phosphate are now mostly grown over.

EXPLORING CHRISTMAS ISLAND BY RAIL

There is nothing monotonous about the trip over the railroad system of Christmas Island. Though only eleven miles long, it includes a long, cable-operated incline and so many picturesque curves that Shay articulated locomotives haul the trains of phosphate, even on the level. It was interesting to find American-made rails and rolling stock so far from home.

The locomotives are all fired with wood cut on the island, but woe to the coolie who, fresh from China, cuts a tree of stinkwood by mistake! The Christmas Island stinkwood really merits its name.

In the cable car we rose above the trees on the incline and could look down on the boobies nesting in the treetops. Changing to a rail motorcar at the head of the incline, we sped along the high plateau. Often we emerged from the forest into camp clearings, passing smiling Chinese coolies who interrupted their Sunday juggling feats and tests of strength to watch the car go by. Then we were back in the forest again, constantly flushing birds feeding on the right of way. We passed a joss house, catching snatches of weird music as we sped along.

At the end of the line lay the phosphate quarries, the sole reason why Christmas Island is inhabited. Located on the higher points of the island, the phosphate beds vary from a few feet to forty or fifty feet deep, usually covered with a thin overburden of soil. Power shovels strip the surface, but the phosphate is loaded entirely by coolie labor, since some selection is required and it is necessary to work down between the limestone pinnacles.

Wondering how anyone had discovered this underlying bed of phosphate, we delved into the island's history. It seems that samples of its rocks were submitted for examination to Sir John Murray, who had been a member of the famous *Challenger* expedition of 1872-76. He found specimens of nearly pure phosphate of lime.

This valuable discovery led to the annexation of the island by Great Britain in 1888, and later to the formation of

LIKE ISOLATED CLIFFS, GIANT ANTHILLS RISE ABRUPTLY ON A FIELD NEAR DARWIN

Built by "white ants" of northern Australia, the mounds are more than ten feet high and exceed six feet in width. They rise in the shape of a flattened wedge (opposite page). These architects really are not ants at all, but termites related to cockroaches.

LINES ASHORE KEEP STRONG WINDS FROM BLOWING "IGDRASIL" INTO DEEP WATER

So steeply does the bottom drop off in Charles Sound, New Zealand, that an anchor will not hold against offshore winds. Only by fastening ropes to trees and rocks could the Strouts obtain a quiet overnight anchorage (page 51).

the Christmas Island Phosphate Company. A daughter of Sir John is the wife of the present manager and was on the island when we arrived.

PHOSPHATE KEEPS HOUSEKEEPERS BUSY

Phosphate is king here, not only for the men but for the women also. The men work with it all day, and so do the women—trying to keep it out of the food and off of the furniture.

Soon even the *Igdrasil* was getting a covering of white powder, inside as well as out, so I didn't mind much when my husband came home one day with large white patches on his clothes. He had crossed a damp spot under the phosphate bins, without realizing how treacherous the innocent-looking white powder can be when wet.

"Now you are one of us," remarked the Englishman who was showing him around. "We all do that sooner or later, and we don't feel as though we belonged to the group until we have taken at least one tumble."

Fortunately it has no odor and is easy to wash off.

Over Christmas Island's one motor road, six miles to the water pumping stations, we drove in an open car. Having no language in common with the Malay-speaking chauffeur, we controlled him by the much-advertised "push-to-stop" system of motor control. A push from behind and the car stopped for pictures; when we were aboard again it went on. As there were no intersections, no instructions were necessary!

Near the pumping station we were fortunate to see one of the large crabs, for this was the off season and there were few around. But during the rainy season these crabs are so voracious that they will attack a man sleeping in the bush. Indeed, they constitute the greatest danger should a person get lost on the island.

MAGNETIC ANTHILLS POINT NORTH AND SOUTH

These homes of "white ants" of northern Australia are called "magnetic" because the narrow sides of the wedgelike structures always face north and south in perfect alignment. Photographed with the camera facing directly north, the hills appear conical and their extreme width is concealed (pages 63 and 64).

TOO BIG A CATCH TO SUIT THE COOK!

The author pulled this kingfish aboard as *Igdrasil* made her way up the east coast of Australia, within the Great Barrier Reef. This husky mackerel is a relative of the species taken in great quantity off the Florida coast.

The crabs are notorious for their ability to climb trees and get the coconuts. Formerly they were found in large numbers on Cocos, or Keeling Islands, but now only an occasional one is found there, while Christmas Island has a great many (page 67).

In the early days fledgling man-o'-war birds often figured on the menu of the first inhabitants, but now one seeks their nests, or those of the boobies and boatswain-birds, out of curiosity only. The Christmas Island pigeons are less fortunate, for they are still esteemed in pies and the Chinese often trap them, though the Englishmen find them too tame for sport shooting.

The Chinese coolies make good cooks. They master the art by watching their mistresses and doing likewise.

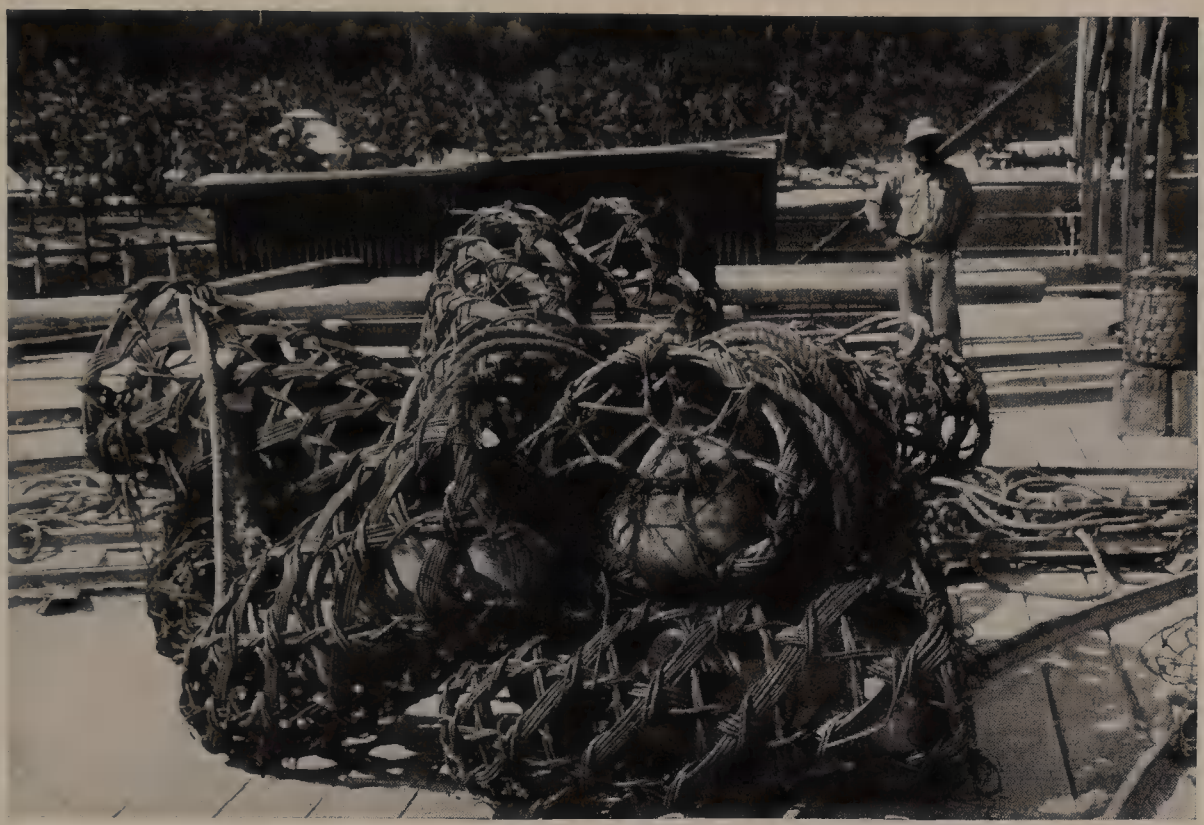
Visitors are rare at Christmas Island, for no passenger steamers stop there. Freighters, mostly Japanese, call for phosphate, and the company's steamer *Islander* makes regular visits to Singapore; but any other craft is practically unknown.

ISLANDS AS FAMILY HEIRLOOMS

We stayed at Christmas Island a week and I enjoyed every hour of it; but the company employees stay three years at a time, and I am sure the six white women on the island envied me my freedom to sail away and not return.

After a pleasant sail of just under four days we arrived at Cocos, where the Malays reported us as "boat all same Captain Pidgeon," referring to the lone circumnavigator who made his second visit here about a year before we arrived.* Of course they did not mean that the boats were alike, but simply that another of those rare but welcome white-winged visitors was approaching the island. Soon two cable company boats and the launch of Gov-

* See "Around the World in the *Islander*," by Captain Harry Pidgeon, in the NATIONAL GEOGRAPHIC MAGAZINE, February, 1928.



PIGS ARRIVE ON CHRISTMAS ISLAND IN INDIVIDUAL PACKAGES

This shipment, from Singapore, is for the Chinese workers employed by the phosphate company which operates on the island, south of Java. English supervisors import their porkers from the Cocos Islands to the southwest, where the animals are more carefully raised. Cargoes of dirt are sent back to barren Cocos as part payment, and used in vegetable gardens (page 71).

THIS LAND CRAB EVEN CLIMBS TREES TO GET COCONUTS

So powerful are the pincers of the red "robber" that they can nip through wire netting as easily as pliers. The big fellows dwell on Christmas Island, in the Indian Ocean. Islanders tell of campers, sleeping out in the bush, who have been attacked by the voracious creatures (pages 65-66).

UNDER THE SPREADING BAOBAB TREES WINDS THE CHRISTMAS ISLAND ROAD

Only one highway penetrates the tiny island, a dependency of Singapore. High in the huge trees, sometimes 30 feet in diameter, grows monkey bread, a gourdlike fruit with a pleasant acid pulp, which may be eaten or crushed into a beverage. Bark and leaves of the baobab trees have medicinal value and the bark also is made into cloth and ropes. The Malay driver of the automobile spoke no English, so the signal for him to stop when the author wished to make pictures was a punch in the back (page 65).

CAVERNS STUD A PLAIN OF CORAL LIMESTONE ON RODRIGUEZ ISLAND

Men with torches guided the author on a tour through the caves (page 79). Fringed by a reef of coral, this small speck on the Indian Ocean is a station on the British cable route between South Africa and Australia.

ernor J. S. Clunies-Ross came alongside to greet us.

Although these low islands were discovered in 1609 by Captain William Keeling, a Briton in the service of the East India Company, it was not until 1827 that J. Clunies-Ross came here with a handful of sailors and took possession of the islands, later laying out extensive copra plantations and bringing over a number of Malays to work them. Since then this group of islands has belonged to the Ross family (p. 70).

Only two are regularly inhabited. Governor Ross and his eleven hundred Malays live on Home, or New Selima Island, on the northeastern side of the lagoon, while Direction Island, to the north of Home Island, is leased to the Eastern Extension Telegraph Company.

AN ISLE FOR MEN ONLY

Cable stations are often in strange places, but this one is particularly isolated. Direction Island is so small that one can walk around it in fifteen minutes; its greatest altitude is five feet, and it is covered with coconuts. Though it is entirely of coral formation, one frequently finds on the shore lumps of pumice that floated here from Krakatau, 700 miles distant, after its tremendous eruption in 1883.

Bearing in mind Direction Island's physical limitations, the cable company wisely insists that the employees stationed here shall leave their wives at home. Since there are no women on the island, the company's usual rules regarding them do not apply, and I found myself being invited to both senior and junior messes.

But the first night I was puzzled. Invited ashore for dinner, we first went to our host's room where the rest of the mess were assembled for drinks. After several hours of conversation dinner was served. So I learned that there it was the custom to have the evening's entertainment, whether cards, billiards, or just talk, come before the meal, dinner being the closing event of the day.

Relieved of all feminine influence, the entire staff grow beards. With Vandykes, Burnsides, and Galways all around me, it was hard for me to believe that most of the men were younger than I! (Page 70.)

The English, more than any other people, appreciate that the first thing a trav-

GOVERNOR ROSS WELCOMES MRS. STROUT TO THE COCOS ISLANDS

For more than a century his family has owned and superintended the group, now a part of the Straits Settlements. He has built a model town on New Selima, known by all the residents as Home Island, where well-constructed houses and shops line the streets. To each newly married couple the governor presents a modest home. The principal crop from this tiny settlement in the Indian Ocean is coconuts (page 69).

VANDYKES, BURNSIDES, AND GALWAYS FLOURISH WHERE NO LADIES LIVE!

Employees of the cable station are not permitted to bring their families with them when they are posted at Direction Island in the Cocos. During the World War a landing party from the German raider *Emden* cut two of the three cables here, but the ship was run aground and destroyed on a near-by reef by the Australian cruiser *Sydney*.

ACROSS THE COCOS ISLANDS LAGOON, "IGDRASIL" GLIDES CLOSE TO PALM-FRINGED SHORES

More than twenty islets group themselves like a necklace about this shallow basin in the Indian Ocean south of Sumatra. The yacht sailed in through an opening in the north side of the enclosing reef. These coral dots were discovered in 1609 by Captain William Keeling and often are called the Keeling Islands.

eler requires is a bath, and all the half dozen or more bathrooms on the station were at our disposal. And what baths! A small waterproof room was fitted with a drain in the floor and a Shanghai jar, a round earthen tub holding perhaps thirty gallons of water. A small dipper floating in the latter constituted the only movable equipment.

The idea of pouring water over oneself with such a dipper may send a shiver through anyone in the Temperate Zone, but shivers are at a premium in the Tropics and under such conditions a dipper shower bath may be most delightful.

No money is allowed at the cable station. In fact the only money in the whole group of islands is the bone coinage issued by Governor Ross for use among his people.

Supplies and personal necessities for the cable station men are purchased on account in Singapore and brought down on the *Islander,* the vessel owned by the Christmas Island Phosphate Company and chartered by the cable company four times a year.

One of the unusual items in the supply ship's cargo is earth to maintain the small garden at Direction Island, which is under the tender care of the doctor. Some of this earth comes from Singapore and the rest from Christmas Island, the latter in return for pigs raised on Direction Island, for the English at Christmas Island will not eat the Chinese pigs brought in for their coolies (page 67).

An occasional novelty in supplies comes when the skipper of one of the Australia-India passenger boats fills a cask with fresh vegetables or other luxuries and throws it overboard for the cable men to pick up.

Home Island, being slightly higher than the others, and having an adequate supply of water from wells, was chosen by the

JACKASS PENGUINS ON DASSEN ISLAND LAY THEIR EGGS FOR THE GOVERNMENT

Collectors for the state monopoly sell for food thousands of eggs, gathered every year on this barren stretch near Capetown, South Africa. Unwary visitors are apt to receive vicious pecks on the ankles from the little "men" (page 81).

Photograph by F. L. Peterson

LIFE ON MAURITIUS, WHERE SUGAR IS KING, CENTERS IN COSMOPOLITAN PORT LOUIS

On this lonely island in the Indian Ocean live 55 members of the National Geographic Society. Into the deep harbor come big ships to load sugar cargoes bound chiefly for Asia and Africa. Although the colony has been British for more than a century, Mauritians speak French (page 80).

A STONE ARGOSY HONORS A GALLANT EXPLORER

Capetown erected the monument to Captain Robert Falcon Scott who sailed from there for the Antarctic aboard the *Terra Nova*. With three companions he reached the South Pole on January 18, 1912, after an exhausting journey, only to find that Amundsen had been there before them. Heartbroken, they began the long trek back and perished on the way. A searching party found their bodies, and Scott's remarkable diary.

Rosses for their settlement. Far from being simply the headquarters of a coconut plantation, it is a model town, with neatly laid out streets, well-constructed houses, many shops, and boat sheds.

NEWLYWEDS ARE GIVEN A HOUSE

The uniformity of housing is traceable to the present Governor Ross's practice of presenting a home to each newly married couple, while the high quality of workmanship in all fields results from a rigorous system of apprenticeship.

There is an excellent Diesel engine-driven sawmill, but the boys who are to become carpenters start their training with whipsaws and continue with them until they can saw straight boards of uniform thickness. Those who are to become blacksmiths finally graduate from bellows boys to making nails, Cocos being one of the few places that still uses the hand-forged variety, even in small sizes. Machinists, boatbuilders, sailmakers —in all the mechanic arts these smiling little Malays were learning their trade with a thoroughness seldom seen anywhere.

Governor Ross owns these islands and all governmental authority centers in him, but his administrative success depends upon his remarkable ability to do anything that must be done in the island better than the people who are doing it. He is a jack-of-all-trades and master of them all.

NO IMMIGRATION ALLOWED

Though Cocos is attached to the British Empire, it is strictly a one-man government. The laws and penalties are sometimes peculiar.

No outsiders are admitted to residence, and any who leave the island may not return, on the theory that tales of grandeur in other countries would tend to breed discontent. This elimination of outside influences makes for social unity and the ban on immigration seems very desirable in a land which, like Cocos, has limited resources and a birth rate higher than desired.

When we were there, one of the men was contemplating leaving on the next boat. As he was an old man, with little chance of financial success in the outside world, we asked him why he wanted to leave. His only reason was that since his wife had died he was living with his daughter, and she would not sew the buttons on his shirt!

There is little crime, as we know it, at Cocos, the commonest infraction of the rules being unofficial marriage before the 16-year age limit is reached, this limit having been set in an effort to hold down

HOMEWARD BOUND!—AT THE CAPE OF GOOD HOPE

On the tenth day out from Durban, the voyagers passed the famous light and felt they were almost home because they were back in the Atlantic Ocean! Alternating gales and calms beset the yacht as it rounded the South African cape (page 80).

the birth rate. The punishment is a certain number of lashes for each party.

But at Cocos a person may assume another's punishment, so in this case the boy takes both his own and the girl's chastisement. Thus he gets a really sound thrashing, after which the marriage is recognized without regard to age!

Some of the island's natural resources have been depleted, principally the land crabs and the birds, for in spite of Governor Ross's order that none of the sea birds should be killed, the Malays can think only of a good meal to be had now, and kill the men-o'-war and the terns whenever possible. So the birds have taken refuge on North Keeling, 16 miles to the northward.

That orphan of the group, incidentally, is the resting place of the famous German raider, the *Emden,* which during the World War landed a party at Direction Island for the purpose of destroying the cables. The *Emden* was surprised by H.M.A.S. *Sydney* and finally was run aground on the reefs of North Keeling.

The landing party from the *Emden* put the radio and cables temporarily out of commission, but graciously spared the refrigerator with its precious food contents. They watched the naval engagement from the roofs of the cable station, and seeing the way it would end, took one of the cable station boats to Home Island. There they commandeered one of Governor Ross's

WING AND WING, "IGDRASIL" ROLLS "DOWNHILL"

Under double spinnaker rig, the yacht made the long run up the South Atlantic, more than 3,000 miles, dead before the southeast breeze. For centuries skippers have welcomed the trade winds. Mariners named them in the days when the word "trade" meant "course" or "trail."

CLIMBERS HALT AT SHADY "ONE-BOAT" ON GREEN MOUNTAIN

Farther along, on the steep, hot, dry road to the top of Ascension Island, in the South Atlantic, travelers find a second resting place, "Two Boats." At the summit they reach a huge elliptical crater, 2,820 feet above the sea. Here cable company employees maintain a farm (pages 82-83, 85).

ON THE LEEWARD SIDE OF SAINT HELENA, JAMESTOWN BECKONS SAILORS TO SAFE ANCHORAGE

The town nestles in a valley between high cliffs, sheltered from the trades which blow against the other side of the island. Saint Helena, where Napoleon died, has since been the place of exile for other political prisoners, including several Zulu chieftains and an ex-Sultan of Zanzibar. During the Boer War several thousand prisoners captured by the British were confined here (pages 78, 85).

ST. HELENA RESIDENTS IN A HURRY SLIDE DOWN THE BANISTERS

Putting a pole across the handrails, they make the quick descent from the top of Ladder Hill to Jamestown in the valley. They touch the steps just enough with their feet to keep their progress under control. The garrison for this small island in the South Atlantic is quartered at the top of the hill. An automobile road also leads up to the barracks. The old moat appears at the left.

sailboats and put to sea, reaching the Netherlands Indies. Ultimately, by other means, they arrived at Constantinople after an epic journey.

The Australian Government tried to salvage the *Emden,* but finally abandoned the attempt because of continually high seas. Afterward, Governor Ross and his able surfmen removed everything of value, but in the long delay the ship had broken on the reef and he still regrets those big propellers that sank into deep water before he had permission to salvage them. For many years, however, the brass gleaned from the ship's fittings supplied his brass foundry.

RATS CLIMB TREES AND DESCEND IN COCONUT "ELEVATORS"

One sea captain, visiting these islands a hundred years ago, remarked that "here crabs eat coconuts, fish eat coral, dogs catch fish, men ride on turtles, and shells are dangerous mantraps."

"It must yet be said," he added, "that the greater part of the sea fowl roost on branches, and that many rats make their nests at the top of high palm trees."

I found no crabs, for they are almost extinct here now, though at one time they were so plentiful that the natives extracted oil from them. I saw, however, the extensive turtle ponds where Governor Ross keeps sea turtles, both large and small, not for the sport of riding, but for food.

The rats have been mostly eradicated, so I couldn't see them burrow into a coconut and then chew off the stem, thus getting a free ride down to earth. We were told that this habit resulted from the fact that while the rats could climb up the sloping trunks they were unable to walk back down. The greatest difficulty with this kind of elevator is that it works only one way.

It is also destructive to the island's economic system, as the only revenue is derived from copra. In an effort to raise more of the island's food supply, Governor Ross has imported various kinds of trees, but the natives' principal food, rice, still has to be imported.

With many examples of fine Malay craftsmanship aboard, *Igdrasil* left Cocos and its happy people and started the long crossing of the Indian Ocean. For the first time in our travels the trade winds blew strongly enough to be interesting for days on end, so we made the 2,300 miles to Rodriguez in sixteen and a half days.

Like so many islands, Rodriguez, now British, was discovered by the Portuguese in the early 17th century. Later the Dutch occupied it for a short time, but it was not permanently settled until 1760 by the French.

"ROCK FARMS" ON RODRIGUEZ

Originally used as a ship-provisioning depot where wild game and wood were available, Rodriguez surprised us by its barren appearance. The reason is not far to seek. A population of 250 in 1847 increased to almost 10,000 in 1936, so naturally most of the available firewood has been burned and the ground cleared for cultivation.

Instead of following the New England practice of making stone walls and a rock pile in the middle of the field, the Rodrigans move only the small rocks, making little piles upon all the larger ones. Thus, from a distance a hillside looks like a "rock farm" instead of a sweet-potato patch.

Excellent paths traverse the island in all directions, and one meets people along them at all times of the day. But no information can be obtained from them, for they know no English, and their patois has departed so much from its original French base that questions in that language are equally fruitless.

Even my husband's sign talk was unavailing, so the magistrate obligingly detailed Mayeuse, his boatman, who spoke a little English, to show us the island. Mayeuse considered it not only his duty but a privilege to accompany us.

There are large limestone caverns at the southwestern end of the island, but they are a long way from Port Mathurin. As I had broken a rib only the week before when tossed against the quarter-bitt by a sudden sea, I thought it would be too much of a walk; so the magistrate provided a boat and, with Mayeuse in charge, we made half the trip by water.

At the caverns two natives lighted us through the underground labyrinth with torches, but Mayeuse, the leader of the expedition, was a waterman and nothing could induce him to go into holes where the light of day had never reached! (Page 69.)

Walking back to the boat, we passed the school, which the French teaching sisters hurriedly dismissed as we approached. Anticipating an invitation, we walked slowly, but Mayeuse, after stopping to talk, fol-

lowed along. Half an hour later he explained that the sisters had wanted me to stop for tea, but since they spoke no English and I no French he had refused without consulting me! It never occurred to him that one could drink tea in any language.

Whenever we rowed ashore the natives would line up on the beach and watch us pull the dinghy up the sand; yet not once did they offer to help. Whenever we came back, there were two deep arcs well marked in the sand on either side, showing where some child had been practicing rowing, safely tied to a filao tree.

The English staff of the cable company and the officials of the island did everything possible to make our stay pleasant. One night when we dined ashore, M. Martin insisted that a guest of his should not have to row home, so he kept a crew of three men in his 34-foot shallow-draft sailing lighter until we were ready to go aboard. Then we sailed out over the reefs in the moonlight, touching gently several times. This was returning in state, for our tender was nearly as long as our floating home and it carried a bigger crew.

Should we mention that we liked any particular kind of food, if it were available on the island it would immediately be sent out to us. Even the two Netherland steamers that came into port during our stay were eager to help and sent over a box of delicacies. So we left here supplied with a wealth of food, as well as many memories of these gracious and hospitable people.

ANOTHER FRENCH-SPEAKING ENGLISH ISLAND

The nearest neighbor to Rodriguez is Mauritius, an island as beautiful as it is historic. Like Rodriguez, Mauritius was discovered by the Portuguese and was settled by the Dutch, who, finding it unprofitable and their escaped slaves troublesome, abandoned the island in 1710 (page 73).

Afterward it was settled by the French, and when the British took possession in 1810, they permitted the inhabitants, as usual, to retain their own language; so today the Mauritian speaks French. The patois-speaking laborers, descendants of the French and the African slaves, have been greatly outnumbered now by East Indians brought here for work in the sugar-cane fields. The population is very dense, about 550 people to the square mile.

The mountains rise abruptly from the plateaus and, with their very jagged outlines and cane-covered valleys, give many splendid vistas as one drives over the island's excellent highways. The mountains add both beauty and distinction to the town of Port Louis, although, surrounding it in amphitheater style, they cut off the usually cool trade wind and make the town hot and stifling.

WORST STORM OF THE VOYAGE

The passage from Mauritius to Africa was in the variables, with the wind boxing the compass about once every three days. Between Madagascar and Africa we met our worst blow of the whole voyage, strong, but of short duration.

Unlike the usual black arch squalls of the Tropics, which we knew so well, this advanced as a solid wall of black, blotting out everything right down to the water as it came. For two hours the resistance of the masts and shrieking rigging was enough to heel the ship far over, while the rain fell at a rate to equal a western cloudburst. Though uncomfortable, the rain was welcome, for it kept the sea from building up.

After the squall came another calm.

Such a tedious voyage gave me time to review all my old impressions of "Darkest Africa," but instead of sighting lions along the coast of Zululand we found that the most conspicuous object was a golf course! It was hard to realize that the smooth fields of sugar cane were indeed the famous Zululand.

As we saw nothing of the natural scenery when entering Durban at night before a northeast gale, friends ashore quickly made up for that by driving us around. Durban is rapidly becoming a city of apartment houses, and many of the buildings of the fashionable residence district are of modernistic design.

We had the usual summer weather for rounding South Africa, some gales but more calms. On the tenth day out we passed close to the Cape of Good Hope, where we were reported by the signal station (page 75). Most signalmen ignore small craft entirely.

Capetown is beautiful at night, as well as during the day, with the lights of the city clustered, as if for protection, at the foot of Table Mountain and Lion's Head. We found a good anchorage in New Basin, farther out than the other yachts. This was an advantage in that frequently I could

NAPOLEON PINED FOR JUST SUCH A "LIFT" FROM ST. HELENA

When the Little Corporal was in exile on St. Helena, his guards watched him day and night to prevent an escape. They were successful, for Napoleon died here in 1821 without repeating his famous flight from Elba. Mr. Strout, left, helps an islander row out to *Igdrasil* in a longboat. The boatman brought the 30-foot craft back to shore by himself!

watch the jackass penguins swimming near the boat in groups of two or three.

Of course I wanted to see the large colony of these birds on Dassen Island, but the Government discourages private boats visiting the place and requires a permit to land. So we found it more convenient to go on the Government tug when it took supplies to the staff on the island (page 72).

PENGUINS PECK INVADERS' LEGS

Many people regard the penguin as a rare bird, to be protected at all times, but in this case the cause of the governmental solicitude is primarily the protection of a source of revenue, for it sells many thousands of penguin eggs every year.

As the tug approached the anchorage one misty February morning, low, barren Dassen Island appeared as one of the most uninteresting islands I had ever seen. But once ashore, the desolate surroundings were forgotten, for all interest centers in the penguins.

One or more families nestle under every bush, while the burrows made by others riddle the hard-crusted earth in all directions. The unwary visitor soon discovers this by breaking through the roof of one of them, and he is lucky indeed if he escapes a vicious peck on the ankle. A sudden retreat is apt to be disastrous, for there are always other penguins just behind you waiting their chance.

The southeasters of Table Bay are interesting to watch—when on shore. First the cloud spreads over Table Mountain like a tablecloth, gradually coming over the edges. The wind rushes down the sides of the mountain to the ocean, where it meets the seas rolling in on the beach. Being an offshore wind, it blows the tops of the waves in the direction opposite to their natural curl, sending up a white spray, reminiscent, to me at least, of the smoke of a prairie fire.

It is hard to convince people elsewhere that these southeasters blow 75 to 100 miles an hour in the squalls without causing the residents the least concern. Apparently one can get used to anything.

A SHOWER OF SQUIDS

We wanted a southeast wind for leaving, so we did not tarry into fall but sailed for Saint Helena in late February, 1937.

South of that island one sunny day we had a rather startling visitation of unwelcome guests from the sea. I was at the wheel and my husband below when suddenly, without the slightest warning, a veritable cloud of squids, about three inches

A REPLACEMENT LINK IN A EUROPE-AFRICA CABLE COMES ASHORE AT ASCENSION ISLAND

The end was floated in from the ship by the large buoys and boats. Although the British navy once attempted to colonize this bit of land in the South Atlantic Ocean 800 miles northwest of St. Helena, only cable company employees now dwell there. Sea turtles visit the coast by the thousands between January and May to lay their eggs. Many are caught and kept in large ponds (pages 76, 83, 85).

MYRIADS OF SOOTY TERNS, OR WIDEAWAKES, WHEEL OVER ASCENSION ISLAND IN MATING SEASON

Wideawake Plain is the name of the cinder-covered valley on this volcanic isle where the birds lay their eggs each year. They always nest facing southeast, headed directly into the trade winds (page 85).

"IGDRASIL'S" SIGNAL FLAGS INTRIGUE A TRIO OF BROWN BOOBIES

The craft was escorted by the tireless flyers while approaching Navassa Island, between Haiti and Jamaica. The birds occasionally closed in and pecked at the banners flying from the mast. The United States owns the island, a tiny speck on the Caribbean Sea, and maintains a lighthouse there.

A PUNCHEON OF BARBADOS MOLASSES TAKES A RIDE ON A "SPIDER"

long, swept out of the water on our quarter and landed all over the boat.*

A couple went down my neck; some fell through the scuttle into the cabin; scores of the slimy things plastered the sails and deck. As they dried they stuck as if glued, and they left their mark with the black ink a squid squirts into the water when pursued by enemies. Cleaning up was half a day's job.

Undoubtedly the squids had been pursued by some predatory fish, and their momentum carried them through the air fifteen or twenty feet. On other occasions a few squids had come aboard, but we had never experienced anything like this. There were probably two or three hundred. There must be an unusual number of them in this part of the South Atlantic, since other small boats have had similar experiences in the same vicinity.

So much has been said about Napoleon in connection with Saint Helena that most people have forgotten its previous long and notable history and fail to realize that its steep cliffs and rugged scenery need no history to be impressive (pages 77, 78, 81).

Old batteries, some built by the British East India Company, appear in almost every view, from the beaches to High Knoll on the crest of the mountains, but the military importance of the station has dwindled until twelve marines constituted the entire garrison when we were there.

ASCENSION HAS GOLF "BROWNS," NOT GREENS

At dawn one morning, seven days after we left Saint Helena, an island appeared ahead. We rubbed our eyes. Was it really Ascension, or were we miraculously again among the Galápagos Islands? It was Ascension all right, but if some giant had plopped it down among the Galápagos, some 5,000 miles to the westward, it would have been right at home. It is more modern, to be sure, for automobiles now go up the 2,500 feet to the farm on Green Mountain as well as to Wideawake Plain.

To this "plain," really a cinder-covered valley, the sooty terns, called "wideawakes," come each year to lay their eggs among the volcanic ashes. All of the birds nest facing southeast, headed directly into the wind (page 83).

* See "Marauders of the Sea," by Roy Waldo Miner, National Geographic Magazine, August, 1935.

On this barren island, originally listed and administered as H.M.S. *Ascension,* the British Navy spent much money and labor, laying out paths, cutting tunnels to connect fields on the steep sides of Green Mountain, planting and maintaining the farm on the mountain, and building concrete water-catchment areas. The island's naval importance having waned, it was turned over to the Eastern Telegraph Company, which now maintains the island as well as the cables (page 82).

The only inhabitants are the staff of the cable company, some twenty-odd men and their families, and about a hundred and fifty workmen and servants who have come from Saint Helena.

Here, of course, one must make one's own amusements. We were puzzled at first by large brown circles scattered over the lava back of the village. These turned out to be golf "browns," for here there is no grass to make any "greens."

MOVIE-GOERS BRING THEIR OWN CHAIRS

Though very isolated, the island has talkies once a week. The major expense of showing the films is borne by the cable company's staff, a small charge being made to the Saint Helenans. A one-eyed Saint Helenan servant registered emphatic objection, contending that he should pay only half price, on the ground that he could see only half as much!

One week we were able to put on an extra show by lecturing about our trip and displaying our colored slides. Chairs were furnished us at the movies, but it is the custom for each person to supply his own chair. Then he has only himself to blame if he has an uncomfortable seat!

A good deal of the food must, of course, be imported, but at the farm on Green Mountain a limited quantity of fresh vegetables is raised. About four hundred sheep are kept here as a reserve supply lest any of the boats be unable to land provisions. A few cows supply milk and butter, but their food must be brought all the way from South Africa.

The Ascension Island housewife buys her fish by the month, paying a fixed monthly rate which entitles her to all she wants, any or every day. Although sea turtles are available, and sometimes a reserve is kept alive in the turtle ponds, they are seldom eaten, as beef and mutton are much preferred.

"IGDRASIL" SPEAKS HER SECOND SAIL NEAR THE CLOSE OF HER VOYAGE

Until they neared the shores of Dominica, on the last leg of their 38,000-mile cruise, the Strouts had encountered only one sailing vessel, *Joseph Conrad* (page 62). Here among the Leeward Islands they meet *J. W. Glise,* a four-master out of Jacksonville, Florida.

Though Ascension, as well as several other islands we had visited, is subjected to occasional heavy rollers, we thought we had missed seeing them. But on the morning we had set for our departure they started coming. We slipped the chain to the mooring buoy and moved farther from shore. The staff of the Eastern Telegraph Company had been so kind to us that we would not leave without saying good-by, and waited two days before we were able to land, even in the company's ably manned whaleboat.

The long run to Barbados was broken by sighting and coasting along the Brazilian island of Fernando de Noronha with its huge undercut rock spire balancing above everything. As one doesn't visit a penal colony except by request, we didn't stop.

NEARING HOME, AFTER THREE YEARS

Back in the West Indies again! To be sure, many miles to the east of our outward route, but to us it was next door to home. Throughout all of these islands an American yacht is not a strange sight, but the harbor officials always had a surprise when, thinking we had come direct from the States, they asked how long we had been out. As they expected weeks or months, the answer of three years was naturally startling.

Crossing our outward path, we experienced again the squally summer weather of the Bahamas, but, boosted along by the Gulf Stream, we were soon out of the Tropics and well on our way to New York, our destination.

SAFELY AROUND THE WORLD, AND THEN—

As we crept up Ambrose Channel at night in a dense fog, the events of the previous three years passed in mental review: three years of strange rocky shores, coral reefs, and sandy wastes; yet three years without adventure. For these natural obstacles are friendly things; they stand still and let you dodge them, and not once had they caused us the slightest damage.

Just then the blast of a steamer's whistle sounded astern, and after much agonized tooting back and forth the bow wave burst through the fog and her steel stem sliced by a few yards to one side. It was a fitting climax to our 38,000-mile voyage in which the major risks had been the dangers of civilization.

LORDS OF THE ROCKIES

Photographing Big Game Animals in Their Primeval Surroundings, from Arizona to Canada, Brings Adventure to Two Wilderness Wanderers

By Wendell and Lucie Chapman

With Illustrations from Photographs by the Authors

PERCHED fifteen feet above ground in the limbs of an evergreen, I gazed down into the bloodshot eyes of an angry cow moose. Under one arm were my still camera and tripod, but how they happened to ascend the tree with me I shall never know.

My wife and I, packs on our backs, had been trudging through the wilderness near Bridger Lake in the Wyoming Rockies.* We were on the lookout for big game. Instead of guns we carried cameras, since we were making for the National Geographic Society a series of natural-color photographs of North American animals in their primitive surroundings.

Squashing over spongy ground, parting bushes with our hands, we had burst into an opening. There, not fifty feet away against a wall of willows, stood a moose with twins, all three craning their necks to browse the tender top shoots.

Lucie scrambled to safety on a rock ledge as I worked closer, trying to get poses of mother and young together. Finally I moved so near the 800-pound animal that her head completely filled the ground glass of my camera. She cocked her ears toward me. Enthusiastic over the grand close-up, I concentrated on focusing.

ON COMES THE MOOSE!

Suddenly the image on the ground glass blurred. I looked up. Here came the moose, ears back, muzzle outstretched! What happened then I do not recall clearly. I went up that tree in a hurry.

* In the Bridger Lake area, Hon. George Shiras, 3d, pioneer wild life photographer and naturalist, discovered and photographed moose on expeditions in 1909 and 1910. (See *Hunting Wild Life with Camera and Flashlight*, by George Shiras, 3d, published by the National Geographic Society, $5.) At that time naturalists generally regarded the big animals as extremely rare in the Rockies below the Canadian border. Investigations showed them to be a subspecies of the well-known Eastern moose and they were named, in his honor, *Alces americana shirasi* (page 102).

In the meantime, Lucie had been photographing a squirrel with the motion-picture camera and had missed the action. When she looked down from the ledge, to see me and the moose glaring at one another, she was visibly disappointed.

"Try it again," she called. "We don't often have a chance to get a picture like that. What grand action—a moose chasing you up a tree!"

I failed to share her enthusiasm, but summoned my courage. When the moose withdrew about 25 feet, I eased nervously to the ground. The result was an anti-climax. The cow, no longer angry, completely ignored me. I took pictures of mother and calves from all angles (page 102). Peace reigned in the willows—but not for long.

Ten minutes later I was up that tree again. Lucie had handed the movie camera down from the ledge and I was busy shooting away when through a dark doorway in the forest emerged the head and shoulders of another moose, a bull this time. Freshly peeled were his antlers and polished for fighting.

Without warning, the bull moose charged on sight. I leaped for the tree and scrambled up, camera tripod bumping against the bark. The bull rushed beneath me, snorting and rattling his antlers in the dipping branches. Once more I sat safely clinging to the perch, hugging the camera.

AGAIN LUCIE LAMENTS

Within fifteen minutes the bull lost interest in me and followed the cow and twins into the forest. Lucie wailed. This time she had seen the action, but I had had both cameras. Down to earth once more I came. Ruefully we suspended moose photography for the day.

We found ourselves following this strange avocation much as a river follows its channel; something irresistible was drawing us on. During the eleven years I was in active

business we spent our summer vacations seeking unfrequented byways in the wildernesses of the West. While we camped from Arizona to the Canadian Rockies, we studied the animals about us, and discovered that we had a knack for gaining their confidence.

Returning home from early trips, we told friends of our experiences—of a mountain goat before us on a sheer wall, running at amazing speed in apparent defiance of gravity; of bighorn sheep lambs butting one another off a huge boulder; of a black bear and a bull elk cavorting about a forest, playfully bluffing one another.

"Why don't you take a camera so you can get pictures of some of these unusual things?" our friends suggested. Some even said frankly, "Why don't you bring back a few pictures so we can believe you?"

DEVELOPING IN A BEAR DEN

So we decided to take cameras. That was seven years ago. When the NATIONAL GEOGRAPHIC MAGAZINE published an article with some of the photographs we made on our first summer's camera tour, we felt rewarded for our trouble.*

Once we used a bear den for a darkroom, heated pans of sand in the campfire to keep developing solutions warm, and washed negatives in a mountain stream.

At one camp deer poked their heads into the tent each morning for graham crackers. At another, a pine squirrel, wheezing from a grass barb in her nose, was always on hand at mealtime, springing to the table, getting into everything and making a welcome nuisance of herself. At a third, a pine marten slipped into the tent during the night to carry away our eggs; and a bull moose with unusually large antlers and wattle, or throat pendant, was a neighbor.

Moose we found not only in the Bridger Lake country but also in the Gallatin Range, which lifts its pyramid crests into southernmost Montana skies. There, five years before, we had had excellent luck with moose, so we pulled the trailer up the main highway along the Gallatin River.

In a valley below the junction of the Beaverhead National Forest and the Gallatin Range, we turned off on a bumpy dirt road. Shadows were creeping down the valley when we drew up to a familiar log cabin squatting among the hills. As we stopped, a wiry, weather-beaten man burst out of the doorway to call off two barking dogs.

A TRAILER FOR A TEPEE

In rolling cowboy gait he came over, extending his calloused hand.

"Hello, there!" he exclaimed. "We've been wondering what had become of you." Looking at the heavy trailer, he added, "Is that your tepee now?"

"Part of the time," Lucie said.

"Back it under that tree, then," the settler suggested.

His wife came running from the cabin, drying her hands on her flour-sack apron.

"You're just in time for dinner," she announced. "I was saying to Jack it was a pity to have so much to eat tonight and no one to help us enjoy it. He's just butchered a sheep and the vegetables's been extra good this year."

Western food and friendliness were at their best. After dinner Lucie helped clear the table while the host and I went out to dig supplies from trailer and car and to see that packsaddles were in order. We had to get an early start next morning, for Jack was to take out a hunting party a few days later.

INTO THE WILDERNESS BEFORE DAWN

Long before sunlight penetrated into the deep valley we rounded up the horses, loaded them with bulging packs of bedding, food, cameras, and other camp conveniences, and were off. The animals picked their way between shrubby cinquefoil, now almost bare of yellow blossoms, to an open stretch dotted here and there with scarlet paintbrushes and late-blooming buttercups.

Above the click of hoof on stone rose the burble of a fast-running creek as our trail turned to follow along the bank. Soon we plunged into the cool of an evergreen forest where going seemed easier, thick needles of lodgepole pine silencing the beat of feet. Smells of pine and spruce mingled in a familiar fragrance.

Midafternoon found us winding along an elk trail through thick timber where we breathed deeply of the cool piny air. Near the edge of the forest the horses tugged the reins from our hands to drink at a rivulet trickling from a clump of lady ferns that concealed a spring.

* See "With Wild Animals in the Rockies," by Lucie and Wendell Chapman, in the NATIONAL GEOGRAPHIC MAGAZINE for August, 1935.

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Kodachrome by Wendell Chapman

HIS CONFIDENCE WON, A MONARCH OF THE FOREST NAPS IN A COOLING STREAM

Mr. and Mrs. Chapman camped several days in the retreat of this wary old bull moose, in the Gallatin Range of Montana. Gradually he became accustomed to the human visitors and totally ignored their close approach. His wide, pointed antlers are losing their velvet. This soft skin envelops the headpiece during its rapid growth each spring.

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Kodachrome by Wendell Chapman

POKER FACE GIVES NO CLEW TO INTENTIONS WHEN HE DECIDES TO CHARGE

The bull moose's back-neck hair rises when he becomes angry, but then it's too late—he's on his way! Twice Mr. Chapman took to the nearest tree when he was charged while making pictures. This powerful fighter emerging from the waters of Mountain Creek in Montana has been rubbing his antlers against saplings. Shreds of velvet still cling to the prongs.

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Kodachrome by Wendell Chapman

FEMININE CURIOSITY GOT THE BETTER OF THIS COW MOOSE—SHE BEGAN TO TRAIL THE AUTHOR

She turned the tables after he had followed her for an hour. The animal showed no hostility, even though her calf (Plate V) was near by. From her neck hangs the moose "bell," a pouch of hairy skin.

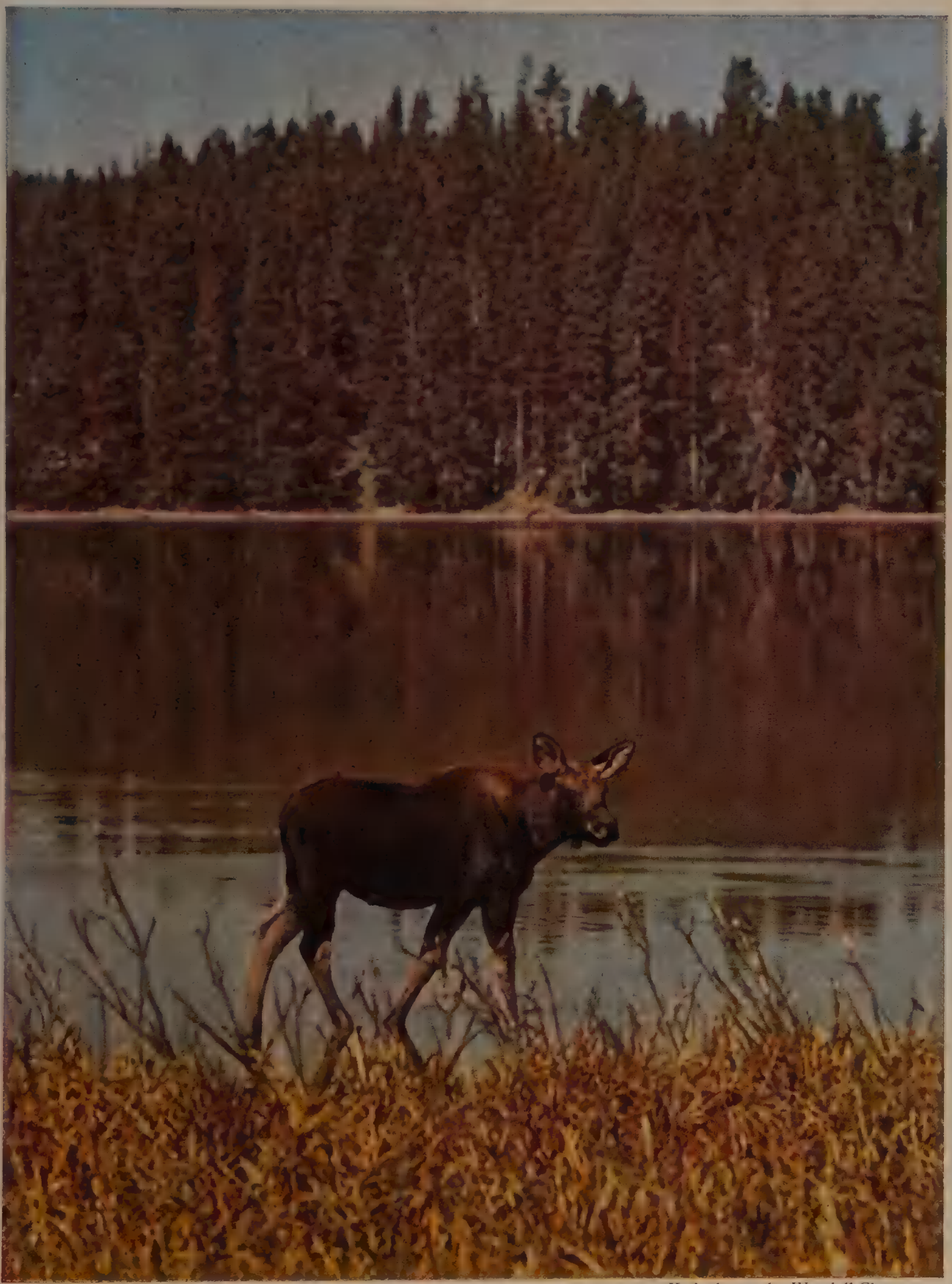
FROM THE BIG SENSITIVE EARS SHE GOT HER NAME—MULE DEER

Cutover timberland, with a second growth, is a favorite feeding place for this graceful animal. When alarmed, she bounds high and wide over the tangled forest, rarely tripping or stumbling.

© National Geographic Society Kodachromes by Wendell Chapman

BASHFUL BLOND AND BRAVE BRUNETTE PEEP OUT AT THE WORLD

The "cinnamon" cub is a full brother of the coal-black youngster. The two color phases often occur in the same litter. In the six months since their birth in the Montana Rockies, each has grown from the size of a grapefruit to a furry bundle weighing about 70 pounds.



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Kodachrome by Wendell Chapman

IN LONG WHITE STOCKINGS A BABY MOOSE GOES WADING

His mother (Plate III) calls to him in low guttural grunts from her feeding place in deeper water. He responds obediently with shrill little squawks. A slight noise, such as the breaking of a twig, although not startling enough to rouse the parent to action, will set up a loud and lengthy chatter between parent and calf. When the youngster grows up, he will be taller than an ordinary horse.

© National Geographic Society

Kodachrome by Wendell Chapman

SECLUDED POOL AND WOODLAND, HAVEN FOR A YOUNG BULL MOOSE, CREATE A SYLVAN PHANTASY

In this former home of beavers, the animal lunches on succulent water plants, most relished item on the summer menu. New velvet-clad antlers are tender. He manipulates his spreading palms so deftly in thick growth that they seldom touch a low-hanging branch.

© National Geographic Society

Kodachrome by Wendell Chapman

AS DO TREES AND GRASS, THE AMERICAN ELK COW MODIFIES HER COLOR WITH THE SEASONS

Yellowish-gray haunches become a deep orange brown in early winter. By spring her whole coat fades to a light buff and often becomes ragged from ticks and general wear and tear. This cow showed no fear as Mr. Chapman approached her in the Montana back country, but her companion, a magnificent bull, fled into the forest. Indians called the American elk "wapiti," which has remained the official name.

© National Geographic Society

Kodachrome by Wendell Chapman

AN ORPHANED MULE DEER TAKES ITS MILK STRAIGHT FROM A KETCHUP BOTTLE

Found abandoned in Arizona foothills, the lonesome little fellow was turned over to its devoted young foster mother, who raised it with care. Mule deer often are incorrectly called "blacktails." The short tail is white, except for a small tuft of black at the tip.

By this same spring we had camped before. Grass and flowers almost covered the blackened rocks of our old campfire, but they did not erase the memory of those days with our friends of the wilds.

Below the camp site lay a meadow containing the unnamed lake where we hoped to find moose. Since last we had seen it the upper end had been filled in with silt and sedges. The small oval of water lay contracting annually within the meadow, whose grassy banks were squeezing it from all sides. A forest marched an advance guard of young trees down to take over both. Already the lake seemed to have given up, for the diminished surface was a solid reflection of encroaching grass and trees.

MOOSE AND ELK RETREAT

From the edge of the timber where we stood, we saw black furrows crisscrossing and skirting the meadow. But we sighted none of the moose and elk that had made them. The clatter of hoofs and the shouting of the guide to the hot, snorting horses had frightened away the wild life, which would not return until he had left with the pack train. Rarely having had luck with wild creatures when other people were present, we were willing to have our friendly guide return home promptly.

The only "assistant" we have ever had was a black bear cub that became intrigued by the insectlike buzzes and clicks of the cameras (page 103). Necessary as guides are, we employ them only to pack us in to base camps, where they leave us to follow the animals in our own way.

From the top of the packs we unloaded the two four-foot parcels containing our folding canvas boat. Next we tossed to the soft grass the rolls of bedding, air mattresses, tent, and folding table. Out of the saddle boxes we lifted more carefully the photographic supplies and food, which we turned over to Lucie. She unpacked kettles while I gathered dry pine sticks for a fire.

Scarcely needing to look, Lucie reached here and there in the boxes, pulling out a package of macaroni, a roll of dried soup, powdered milk and salt, and had them in kettles ready to boil. She mixed up a pan of biscuits which I baked in the reflector oven before the open fire. Crackers, macaroni and cheese, gooseberry jam made from wild berries gathered in our last camp, and tea completed the lunch.

We do not use any stimulant except weak tea with a tablespoonful of honey per cup. After a 20- to 30-mile hike, a pint of this "pick-me-up" revives us completely in 15 to 20 minutes with no let-down afterward. The fact that we do not smoke has proved fortunate, for we have been admitted to areas closed to the public because of fire hazard. We never carry guns.

SELECTING A CAMP SITE

We chose a site beside the silver branches of a sturdy alpine fir, whose candlelike cones stood up as if to light our camp. Here we pitched the tent behind a hedge of alders and willow clumps bordering the rivulet.

On this location the rising sun dried out dew and gave warmth; yet the forest wall afforded protection from wind and furnished shade during the heat of the day. The camp was concealed from the lake and meadow on which we expected to see moose and elk by peeping through a lattice of willows.

With all our precautions for concealment, suddenly the chatter of a pine squirrel ripped the silence of the cool valley as she announced our presence, at the same time berating us for intruding upon her homestead.

At her first volley Lucie dug into our bags for shelled almonds, pecans, raisins, and crackers, which we put on rocks and fallen trees. Canada jays, called "camp robbers," swooped from nowhere to feast on the offerings, but before our sleeping bags were unrolled and the boat set up the pine squirrel discovered the bribe and complained no more (page 99).

FOUR TROUT IN 15 MINUTES

Before the sun left the silent valley we unpacked fishing rods, fitted the wooden keel and metal ribs into the canvas boat, and pushed out through slapping wavelets into the lake.

At one end we found deep water where within 15 minutes four large trout exploded the surface and made the lines sing before giving up. We had all the fish we could eat for dinner and breakfast.

Carrying the boat up the slope, we turned it upside down near the tent, so no evidence of our presence would be visible from the lake. Also, the craft afforded a shelter for our provisions.

A PINE MARTEN BRINGS HOME THE BACON

Lured by the tantalizing odor, this graceful American sable scampered down the tree to snatch the slice (pages 99 and 114). Sharp claws rattling on the bark, he darted back into the high branches. He can leap four-foot gaps in the treetops with the agility of a squirrel.

During the evening we peeped through the hedge of willows, expecting to see moose and elk in the lake and meadow, but the splashing oars and the tang of campfire smoke kept them away. After dinner we carefully packed our food, and, when all was still and dark, crawled into our sleeping bags.

In the night a stick snapped just outside the tent. I jumped up and played the flashlight about. Two bright spots burned back. Crash, thump, thump—into the forest fled some large animal.

In previous years we had been frightened by a similar commotion in the dark, thinking it was a bear, but now our ears told us that it was a mule deer. From the sounds we could visualize the peculiar gait of the animal. We heard it, all four feet together, bouncing in and out of small openings among tangled, cutover timber where another kind of deer, a dog, or a wolf can hardly penetrate. Whenever an animal goes bounding away as if on a pogo stick, we know it is a mule deer.

SALT AND GRAHAM CRACKERS LURE A MULE DEER

"Put out salt and graham crackers," Lucie suggested, "on that old stump where we can see it from the tent in the morning."

The bait set out, soon we dropped again into sound sleep, to awaken only at dawn when boisterous gabbling of mallard hens in the lake roused us. Thumping of hoofs beside camp snapped us upright in bed. Thrusting our heads out the tent, we saw our night visitor, a mule deer doe, chasing another from the salt (Color Plate IV). They bounded away in stiff-legged leaps three or four feet high, easily clearing currant bushes and tangled timber.

In the chill air we dressed rapidly and started a warming fire. Lucie then went for the fish, which we had placed under the upturned boat.

"Didn't you put two fish in here?" she

asked, picking up the pan, which held but one.

"Why, the larger one is gone!" I said. "Maybe we heard a bear after all."

"No! A bear wouldn't have taken a single fish, and he'd surely have overturned the boat."

We did not have to wait long to solve the puzzle. Lucie was serving bowls of oatmeal with dates when the rattling of claws on bark on a limb overhead brought us up with a start.

"There's the little scamp!" Lucie cried.

A PINE MARTEN ASKS FOR MORE

A graceful pine marten, or American sable, clung with ebony claws, cocked his kittenlike face at us, and wiggled a sensitive nose toward the remaining trout now frying in the skillet. Lucie cut a piece of bacon rind and fastened it on the tree trunk to lure him while I adjusted camera on tripod (page 98).

RAISINS BRIBE A FOREST CHATTERBOX

So tame did this pine squirrel become that she gave the campers little peace unless she was pampered. Mrs. Chapman quieted the noisy intruder to the Rockies camp with gifts of shelled almonds, pecans, and other dainties (page 97).

By early afternoon the pine squirrel became confident and kept us busy digging into bags and boxes for dry oatmeal, nuts, and crackers. Whenever her chatter was of fright, wild neighbors heeded her warning; but when it was from anger, they paid no attention to her noise.

Hardly had the squirrel ended one of her tirades at the jays for robbing her treetop store of crackers than we heard a twig snap not twenty feet away in a clump of evergreens behind us. Cautiously we turned. From a hole among the branches of a lodgepole pine protruded a long, dark head with alert ears. Sunlight glistened on the homely face of a cow moose.

We were not afraid of this cow, despite my experience with the other one. Wild animals do not go about looking for trouble.

Our moving about for close-ups interested her, but she did not eye us intently as if hostilely inclined. Instead, she casually watched a few minutes, then grunted. From somewhere behind her came a high-pitched answer. The head disappeared.

A minute later the cow emerged down the slope, on the way to the lake, a stilt-legged calf capering after (Color Plates

SWIRLING WATERS SWAMP A WOODLAND CAMP

The authors awakened one night to find their tent in the center of a Canadian Rockies "river" 150 feet wide and one foot deep. Four inches of rainfall in 24 hours produced rushing streams where none had existed before. By the time cameras and film were rescued, other equipment was eddying round and round in the tent.

III and V). Leisurely they browsed to the lake, turning to look at us every few minutes.

Out in the water the mother ducked her head to feed on the succulent underwater plants. Each time she came up for air she grunted to the calf, which answered from the grassy shore.

When we approached to within a few yards of the young one, the dialogue between it and the mother grew into an excited chatter. But the cow, remaining in the water, seemed to realize that we were friendly and soon paid little attention to us. Her visit to our camp was the beginning of an unusual comradeship between us. During the days that followed, we trailed the pair almost as unnoticed by them as if we had been other moose.

TRAILED BY A COW MOOSE

One morning as the cow slowly moved among the willows, browsing, we followed only a few feet behind her. After an hour she swung around, intently focusing eyes and ears in our direction. We feared that this interest in us might be a danger signal, and so Lucie withdrew with the motion-picture camera while I sat upon a log with my still camera.

The moose grazed so close I could have reached out and stroked her coarse hair. I rose and edged away. She turned and, for an hour, followed a few feet behind me, looking up often, seeming to enjoy my companionship.

Nor was she the only friendly moose we found while encamped at the lake. By sunrise one morning we started over a ridge for a pond, below a V-shaped patch of aspens on a distant mountain slope. Even though we had marked the location, it was so long since we had visited the little lake hidden in the forest that we spent most of the morning trying to find it.

The "laughing" of a loon at last directed us through the forest to the pond. At the timber's edge we stopped to photograph deep-blue fringed gentians, darker monkshood, and rosy mimulus growing along the damp bank of the spring-fed trickle.

As we sloshed from the spring into the marshy sedges, Lucie stumbled upon a

LIKE A SHOT OUT OF A GUN, BRUIN LEAPS FOR LIBERTY

Because he has been bothersome to visitors in Yellowstone National Park, rangers have carted him about fifty miles away for punishment. He loathes the truck ride and loses no time in making an exit when the end gate is raised.

BY A SHORT CUT HE SPEEDS BACK TO THE CAMP GROUNDS, WHERE FOOD MAY BE HAD FOR THE BEGGING

The black bear knows that succulent gifts from campers await him at the end of the trail. An old bear with cubs once outwitted the Chapmans in Yellowstone and got more than her share of supplies from their tent (page 113).

HOW CLOSE MAY HE GO? MR. CHAPMAN TURNS A MINIATURE COLOR CAMERA ON A SHIRAS BULL MOOSE 60 FEET AWAY

This subspecies (*Alces americana shirasi*) is named for George Shiras, 3d, the veteran naturalist and author of *Hunting Wild Life with Camera and Flashlight*. He found moose in the Bridger Lake District of Wyoming some thirty years ago when they were believed to be nearly extinct in the Rockies.

THE COW MOOSE HAD JUST CHASED THE AUTHOR UP A TREE, BUT NOW SHE IGNORES HIM AND PEACEFULLY JOINS HER TWINS

When he tried to induce her to repeat the attack so that his wife could get photographs, the animal refused to budge (page 87). Taken near Bridger Lake, Wyoming.

"ARE YOU READY, MOTHER?"

The only assistant cameraman the Chapmans ever had was this black bear cub in the Gallatin Range, Montana (p. 97). Teddy's firm grasp on the tripod of the motion-picture camera gives an unusual close-up of his left forepaw. Only one of the short claws is visible. His five toes are equally well developed.

EARLY RISERS—BUT THEY BREAKFAST AT 10:35!

Strenuous morning field work preceded the meal. The two-room trailer, equipped with water tank, range, fan, and other conveniences, is the authors' base camp in the Rockies. Warm baths in the built-in tub are luxuries after several days on the trail. The gate-leg table seats eight persons (page 113).

bleached antler which had been shed several years before.

Picking it up, she exclaimed, "Why, it looks just like the 13-point antlers of that big fellow we saw five years ago in this same valley—the big black bull who had the prize wattle, remember?"

"Then he must winter here, too," I replied, knowing that moose in the Rockies shed their antlers about January.

"I wonder where he is now?"

"There are plenty of willows and evergreens in this valley for him to eat. If he stays here winter as well as summer, maybe he's not far away now."

"Looks as if porcupines have been gnawing the points," Lucie said, looking at the antlers. "Or maybe it was a coyote."

Scarcely had we started on than a huge, dark moose sprang up in front of us, turned his head, eyed us, then trotted off.

"That's the very bull," Lucie said.

"I'd know that wattle anywhere," I agreed, watching the long flap of hide and hair swaying under his throat as he walked.

"But his antlers——"

They looked more like large deer antlers than the huge shovel affairs with points and prongs which he carried when first we saw him. His sleek body sagged only slightly with age, but during our five years' absence he had passed his prime. With waning strength, each successive summer he had grown smaller and smaller sets of antlers until this year's growth was almost devoid of palms. He was now in his decline, and his antlers were hardly heavier than when he was a four-year-old.

MOOSE TO RIGHT, MOOSE TO LEFT

It was difficult to steady the tripod legs firmly on the marshy ground where he began grazing, so I hurried through the forest to get in position for a better picture.

Suddenly I heard a crash. Up from a willow clump shot antlers and body of an enormous bull. He glowered down upon me, rags of bloody velvet hanging from his massive antlers. I froze in his presence. Up popped two young bulls. Then Lucie scared up a fifth. We were in a moose "ambush." In all, seven arose about the pond (Color Plates I, II and VI).

We followed the largest bull. He drew away. Disturbed by our approach, and restless from the itching of the drying antlers, he threshed willows and saplings, rubbing more skin from his weapons. We approached as close as we dared—about 60 feet when he was standing and 25 when he was lying down.

On the way back to camp we entered a small clearing in the evergreens where we surprised, grazing on yellow grass, an elk cow and a bull with six-pronged antlers. Slender legs, luxuriant mane, and proudly held head gave the bull a regal presence as, alert and intent upon us, he stood for a moment beside the cow (page 117).

ELK COW POSES; BULL RUNS AWAY

His majestic bearing vanished as he saw us and bolted. Nimbly winding through the trees, head weaving from side to side to avoid hitting his cumbersome antlers, he seemed almost to float up the mountain.

Two hundred yards away the elk circled behind a clump of firs and stopped. He eyed us through a hole in the branches, exposing only part of his face. Every few seconds he coughed an explosive warning bark to the cow, which stood quietly watching (Color Plate VII).

Almost a duplicate of the bull in size and color, she lacked his headdress and majesty. She watched us while, in full view, we adjusted cameras on tripods and moved about for better angles and light. Elk are nervous, wary creatures, which migrate with the seasons. During the late fall they are killed by the thousands. Therefore it was a surprise to find this cow so unafraid.

Next morning we broke camp and packed the horses before the sunshine had dried the dew from the tent. Hearty appetites, the result of hiking 150 miles in 10 days, had left little food to pack. Once started down the trail, we made good time, for we were as eager to return to our base, the trailer, as the horses were to reach home and oats.

Long before shadows fell we were back at the ranch. We asked the packer and his wife to have dinner with us in our two-room home on wheels.

In the trailer Lucie exchanged high boots and breeches for light, clean clothes from two cedar-lined, full-length wardrobes while I pumped water from the tank and heated it on the gasoline range. Warm baths in the built-in tub were luxury after the cold ones in the lake. The convenience of the shaving cabinet was appreciated after I had used a tiny mirror hung on a tree in camp.

ALERT AND WARY IS THIS PRONGHORN, ATTRACTED BY AN INTRUDER

Often while his fellows rest or graze, a watchman ascends a knoll where he has an unobstructed view in all directions. When he senses danger, he gives a snorting bark and the whole group of curious antelopes gallops up the hill for a look. If trouble seems near, away they bound.

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MOTIONLESS, A PRONGHORN SUSPICIOUSLY WATCHES A RIVAL BUCK

The tawny creature paid no attention to the author and was too lazy to pose, until another antelope appeared. Now the animal stands rigidly at attention, heedless of the blades of grass in his mouth.

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Kodachrome by Wendell Chapman

STATUES IN SILHOUETTE AGAINST A WINTER SKY, PRONGHORNS WATCH TENSELY AS A COYOTE MOVES ON A DISTANT HILL

When snows retard their speed, the animals are more wary than ever. They eat sagebrush in winter, because grass is so deeply covered that they cannot paw it out. Sometimes, in severe weather, they come down from the rough Devil's Slide country, north of Yellowstone, to lower farming lands, seeking forage. The pronghorns are a distinct family. Their hollow horns are shed each year and new ones develop over the remaining bony core.

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Kodachrome by Wendell Chapman

"WHAT YOU SEE CAN'T HURT YOU" IS THE PHILOSOPHY OF THE PRONGHORN

Telescopic vision enables this buck to see much farther than a man. From his vantage point on the edge of a canyon in the Montana Rockies, he detects a moving object. In vain the author swept distant slopes with binoculars, trying to find what attracted the antelope's attention.

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Kodachrome by Wendell Chapman

FLEETEST QUADRUPED IN NORTH AMERICA IS THE PRONGHORN, CLOCKED AT 60 MILES AN HOUR

The cheetah, or hunting leopard of Asia and Africa, can exceed that record, but only for short spurts. So confident is the antelope of its superior speed that it invariably cuts across in front of pursuers, apparently to be tantalizing. One crossed the path of Mr. Chapman's automobile while the car was traveling 45 miles an hour. When a pronghorn is alarmed, the long white hairs of its rump patch rise on end to form two large chrysanthemumlike rosettes.

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ONCE A ROAMER OF THE OPEN PLAINS, THE PRONGHORN HAS BEEN FORCED BY MAN INTO ASPEN GROVES IN THE HIGHLANDS

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DEEP IN THE BACK COUNTRY OF YELLOWSTONE DWELL REMNANTS OF AMERICA'S GREAT BISON HERDS

When white men first came to America, buffalo roamed the Plains in countless millions. After the Civil War, as the railroads pushed westward, reckless slaughter of the bison began. By September, 1883, only one large herd of about 10,000 head was left. Sitting Bull, accompanied by white hunters, found them in a North Dakota canyon and exterminated them in less than two months.

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BISON GLARES AND A RISING TAIL WARN THE AUTHOR, 40 FEET AWAY, TO COME NO CLOSER

Unlike white hunters, Indians killed only enough buffaloes to supply themselves with meat and hides. When destruction was at its height, the ancestors of this small herd drifted into Yellowstone. Now they are thriving under protection.

HUGE HEART AND LUNGS GIVE THE BISON REMARKABLE ENDURANCE

The author has seen a shaggy giant run nearly 40 miles in one day, tiring out three sets of horses. Usually lethargic, the buffalo exerts himself only when pursued.

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Kodachromes by Wendell Chapman

THEY PREFER THEIR MEAT COOKED, THANK YOU!

When Mr. Chapman gave roast beef to these pet badgers on a Nevada ranch, they ate it greedily, turning away from their regular diet of pocket gophers. Later they buried the gophers for a "rainy day."

Refreshed and clean, we were soon at work. Noise from the typing of my notes filled the front room while Lucie's rattling of pans and the soft whir of an electric fan made the kitchenette hum. Through the sliding doors, the rhythmic sounds of a spoon clanking inside a mixing bowl told of a cake in the making and aromas revealed that it would be devil's food with chocolate-pecan frosting.

An hour later a knock at the door announced Jack and his wife, who stood with fresh beets and carrots from the garden, a loaf of homemade bread hot from the oven, and a pitcher of milk.

Lucie called, "Dinner is ready."

DINNER FOR FOUR IN THE TRAILER

We seated ourselves at the gate-leg table in the front room where a delicious dinner was served on colorful china. We were not crowded, for we have served as many as eight. After dinner, our guests were intrigued by the electric lights, bookcases, typewriter stand, numerous drawers, storage cabinets, closets for brooms, linen, and sewing. They could not understand how there could be so many built-in conveniences and at the same time so much room in a trailer 20 feet long by 7 wide.

Next morning, with cupboards and icebox full of fresh vegetables, eggs, milk, and butter purchased at the ranch, we started for the highways of Yellowstone Park.

Ordinarily the best wild-life haunts are not along the roads, but some of the national parks prove an exception, particularly the Yellowstone.

Near the hotels and camps more black bears gather than we ever see in the wilderness. Free to come and go as they please, these bears enjoy the normal activities of wild bears, which they are. They spend days in the woods gathering fruits and berries, cropping grass and herbs, digging roots and ground squirrels, and tearing apart logs for grubs and mice.

AN OLD MOTHER BEAR OUTWITS US

But the camp and highway bears have also learned to match wits with man. In foraging for food they use to the utmost their native shrewdness, and we find them exasperatingly and embarrassingly clever.

While we were cooking breakfast on the campfire one morning, an old bear with cubs appeared on the slope above us. They sat peering through the trees, sniffing at the frying bacon. Unlike most bears which hang around camps, this family ambled off into the timber.

Because the morning was frosty we ate inside the tent, closing the flap against the cold. We left our food stores just outside under the fly, thinking that the bears were gone.

All was silent outside until we arose to clear the table. At our stirring, pans clattered and feet thumped the ground. We dashed out and saw the old bear romping toward the cubs, a pail of flour dangling from her mouth. I ran after her. Upon reaching the cubs she punctured the can with her teeth, then dropped it, and all three scuttled up the mountain. At the spot where the cubs had sat, there lay the wrapper of our new slab of bacon, the honey bucket licked clean, and a messy rag—all that was left of our oatmeal.

The old bear had outwitted us. Having been stoned out of many a camp, she was too smart to come into ours when we could see her. From concealment she had watched and, the moment we closed the tent, she had stealthily slipped in again and again to select choice packages for herself and cubs. On her last trip, having been interrupted by our coming out of the tent, she had grabbed the first package within reach. Upon discovering it was only flour, she dropped it.

Having come to understand the nature of black bears, we feel absolutely safe in their territory. Ordinarily a stone or stick of wood will send them flying. Sometimes we see and photograph bears in wild country (Color Plate IV), where we have no fear of them, for in the wilderness black bears are one of the least dangerous of all big game.

GRIZZLY BEARS REFUSE TO BE BLUFFED

Grizzlies are entirely different. Photographing them is uncertain and hazardous. They are nocturnal in their habits and larger and more fierce than the blacks. They appear only rarely and unexpectedly. Usually they shun people, but if surprised at close quarters they are likely to charge.

Last summer I was standing alone on a mountainside above timber line in the Rockies, color camera on tripod focused on a flock of bighorn sheep 150 feet away. Behind me the silence was broken by a clatter of rocks. I wheeled. Two grizzlies, not 50 feet off, hair bristling, mouths

BABY MARTEN DAINTILY SIPS HONEY FROM A SPOON

A rare visitor to the Gallatin Range camp was this young American sable, or pine marten, not old enough to be as suspicious and wary as his parents. When they hunt mice, squirrels, or other prey, they often stand on their hind legs to peer about. Their rich brown coats threaten their existence, for hunters pursue them in winter for their pelts (page 98).

open, galloped down upon me—not a tree or cliff near, no possible escape.

Facing the charging animals, I shouted, swinging the lens toward them. At thirty feet they halted. One reared, head and shoulders silhouetted against the sky. The other stood facing me. In the background curved a magnificently rugged mountain range—a setting that comes once in a lifetime.

Instantly I decided to snap two pictures, then check for focus and take more. I had barely snapped the camera when the rampant bear dropped to all fours. Both milled behind boulders and disappeared into a ravine. I rushed after them. In full sight the grizzlies ambled over a rock slide below me. I got two miserable pictures. Down a ledge I scrambled, following the pair until they disappeared into timber where I dared not follow.

GRIZZLIES PAY US A CALL

Later one October evening we decided to try for flashlight shots of grizzlies near the main loop road in Yellowstone Park. We planned to spend the night in our trailer, in a valley near the Canyon feeding grounds. With the tourist season over, park employees had recently discontinued the daily serving of table scraps to the bears.

At our camp site I poured half a sack of oats on the ground twenty-five feet from our car and trailer. Then I fastened a flash reflector on a stake beside the bait, and ran the opposite end of the cord with battery and switch through an open window to the camera. With more oats and other food on the floor inside the door, and a supply of flash bulbs and film ready beside the camera, we retired.

Scarcely had we turned out the light and pulled up the covers when we heard a familiar breathy "woof"—a bear vigorously exhaling a blast of air. Delighted

SNOWBOUND IN THE ROCKIES—BUT SNUG AND WARM IN A TRAILER HAVEN

Held fast by blocked roads, the authors caught up with accumulated work. Darkening the kitchenette, they developed negatives and then hung them up in the living room to dry from the heat of gasoline stove and lanterns (page 120).

at the sound, I got out of bed and tiptoed to the camera at the other end of the trailer.

In the starlight loomed an enormous grizzly. Deliberately he swung his ponderous head toward the trailer, then moved on to the pile of oats, where he stopped to munch. I touched off the photo flash. The flare showed a bear slumped over—a shapeless hulk, head hidden by grass.

Immediately I turned on the searchlight. The old bear had not moved. That was not according to rule. Always before, grizzlies had fled at the glare of the flash. Now, caught in the steady beam of light, the big fellow looked up and continued eating unannoyed.

Crossing the trailer floor, I turned the searchlight out the back window. There stood another grizzly. From a third window more grizzly eyes reflected the beam: a wide pair here, a narrow pair there; a wide pair with a narrow pair on either side beyond—a mother and cubs. Eyes burned back from every side as I flashed the light. Another huge form loomed between car and hitched trailer, and ambled over to join the feeding grizzly.

The circle of eyes drew closer, bodies of bears gradually growing visible under searchlight illumination. Frosty air popped from their nostrils. All about in the dark we heard snorting exhalations. When the pile of oats was gone, the pair of feeding giants sat up and waved their noses inquisitively toward us.

Lucie whispered, "The food!"

TRAILER STORES NEXT ON GRIZZLY MENU!

Chills raced along our spines; our trailer was redolent of food! Bacon, fresh meat, fruit, sugar, honey, everything bears like. And between us and the grizzlies only frail trailer walls!

In a feverish desire to get rid of the bears, we forgot all about pictures. It dawned on me that grizzlies have sensitive ears and are panic-stricken by din. Beneath the sink I dived and snapped out a dishpan and basin. Out of the window I banged them, frantically. The bears merely pricked up their ears at the clatter and began moving in upon us.

In a cold sweat I set those pans on the floor without a clink. Banging was the grizzlies' dinner call! In clanking gar-

bage cans Park employees had brought food to them all summer long. The bears kept moving in, ears cocked and noses waving expectantly.

Desperately I grabbed the lantern and lighted it. I jumped about the trailer, rocked it, waved the light, shouted. I set the lantern at one window, threw out flash battery and switch from the other open one and closed it. A few paces away half a dozen bears sat down, ever waving their noses toward us. The others, disliking the light, withdrew until only their eyes shone in the darkness as they watched.

"Let's get out of here," Lucie urged.

"That's just what I'm trying to do," I replied. We had been in tight places before with wild animals, but this was the first time I ever found Lucie concerned.

DOWN A GRIZZLY-LINED PATH TO SAFETY

Grabbing a lantern, I rushed for the door, swung it open, leaped to the ground. I snatched up a piece of firewood and hurled it toward the nearest grizzly, but was mighty careful not to hit him.

With all my bustle and bluff the grizzly did not run. He just eyed me. Tensely I watched for signs of bristling. After a terribly long time—it must have been four seconds—he turned aside, his hair yet smooth.

Gripping the lantern in one hand, I snatched up the ax with the other, vigorously whammed the ground, and shouted. The old fellow withdrew a few paces, but so deliberately! Others began edging away slowly.

Clad only in pajamas and slippers, lantern and key in one hand, ax clutched in the other, I mustered up courage to dash from trailer to car. Luckily they were still hitched together and ready to go. Over frosty grass I raced.

Through habit I had locked the car door—out there in that no-man's-land! Quickly I forced the key into the lock. Through a blockade of bags and boxes piled to the roof, I dived, excavated the pedals, started the car. Off we lurched in low over the bumpy road.

A mile away I stopped and went into the trailer. Lucie, flashlight in hand, was prospecting the floor, picking up cushions, pans, and packages of food which had come crashing from everywhere and lay in a swirl of rice on the linoleum.

"That's about the roughest ride I ever had," she said. "But I'm glad we got out of there."

BISON'S TAIL IS A DANGER FLAG

After the grizzly experiences, we were ready for less exciting quarry and soon were following bison, or American buffalo. Although this animal appears clumsy and immobile at rest, he can handle his weight with remarkable agility. The bulk of his huge frame centers over pedestal-like front legs. On these he pivots in the manner of a skilled boxer. Once he charges a man afoot, there is little chance of evading this unbluffable ton of fury.

Notwithstanding the buffalo's treacherous nature and enormous strength, we consider him one of the safest of the big game animals. One little "giveaway" to his mood is his ridiculously small tail, which he hoists when perturbed. The greater the agitation, the higher goes the tail.

After snow fell on Mirror Plateau, which is 8,000 to 9,000 feet above sea level, we drove out to the Lamar Valley to ask a veteran ranger, Joe Douglas, if the herds had come down from their summer range.

"By the time the aspens turn color," he said, "you'll find some buffalo up there on top of Specimen Ridge or in the Horseshoe."

"Can we get near them?" Lucie asked.

"You'd better keep downwind and out of sight. They generally run."

"And if they don't?" I asked.

"Then you do," Douglas chuckled.

"Too bad you don't have the same chances to see buffaloes that the old-timers did," he added. "You didn't have to come clear to Yellowstone to see 'em then. The ones here just sort of drifted into the back country about sixty years ago to get away from the hunters.

BUFFALO HERDS BLOCKED TRAINS

"When I was a boy I heard many an old pioneer talk about the buffaloes all over the Plains this side of the Mississippi. There were millions of 'em. When the transcontinental railroads were being built, a train would be held up for hours as a herd crossed the tracks, for the bison were so thick an engine couldn't plow through without derailing. The passengers would take pot shots at them out of the coach windows, and let the dead ones pile up for amusement.

IN STIRRING NOTES AN AMERICAN ELK BUGLES HIS LOVE CALL

Beauty and duration of tone reveal the strength and maturity of this wapiti bull (page 104 and Plate VII). The musical cry, piercing the autumn air, also is a challenge to rivals. Closely related to the European stag, the wapiti, with its superb, wide-branched antlers, once ranged most of the United States. Today it is confined principally to the western mountains.

"When a herd decided to cross a river, it would hold up a steamboat for the better part of a day. Hunters, bringing in bison meat for the railroad crews, and pelts to send back East, would kill several thousand apiece in a season. Sportsmen used to come all the way from Europe just to shoot buffaloes. The early Indians never killed 'em that way. They just killed enough to get meat and hides for themselves."

"When did the wholesale slaughter finally come to an end?" I asked.

"Well," replied the ranger, "Sitting Bull with his tribe and some white hunters killed off the last big wild herd—about 10,000 of 'em—over in North Dakota in '83. In less than two months they killed 'em all."

Day after day, with heavy packs, we tramped the mountains to the edge of the snow-covered country. Fresh signs were plentiful, but it was nearly a week before we found the animals. Then one morning just over the crest of a ridge we came face to face with seven large bulls. Into the air went their tails. They bolted before we could get cameras out of knapsacks.

Veering to keep upwind, we followed their tracks over rolling yellow slopes, through patches of evergreen timber, and within an hour caught up with them beside an aspen grove, brilliant in the early sunlight. This time they saw us at a distance. Again up went their tails, but they did not run. Quietly we waited until the danger signal was lowered before advancing. Eventually we worked to within a few yards (Plates XIV, XV, and XVI).

CLOSING IN ON YOUNG BIGHORN RAMS WITH THE COLOR CAMERA HIGH IN THE MONTANA ROCKIES (PLATES XVII TO XXIV)

As we stood watching the buffalo, four pronghorns, or American antelope, calmly walked past. Formerly both buffalo and pronghorn roamed the Great Plains west of the Mississippi in numbers greater than the human population there today.

ANTELOPE ARE FLEET, BUT CURIOUS

Once in danger of being exterminated, antelope are now numerous on many open ranges in the West. The fleetest quadrupeds native to this continent, and possessed of telescopic vision, they would be difficult to approach were it not for their extreme curiosity. Typical was the herd which we lured to within a few yards of us with a hat hung on a bush, a trick formerly used by hunters who nearly wiped out these graceful creatures.

We endeavored to win their confidence by coming out in the open and talking to them, as we do with beavers, otters, goats, and trumpeter swans.

Below Electric Peak in southern Montana, where rolling grassy hills break away from evergreen and rock-clad mountains, an antelope buck showed unusual confidence as I trailed him and talked softly. By the end of the third day he ignored me, although I approached almost within touching distance. His indifference presented a problem, for he merely grazed peacefully, groomed his coat unconcernedly, or lay down sleepily.

I tried attracting his attention by coughing, but after turning his head to look at me, he paid no further heed. Even when I shouted, whistled, jumped about, and became boisterous, he simply strolled away a few paces and continued what he was doing.

For several days I trailed the buck, hopeful that he would become alert. The poses I did get are the result of his spying at different times a coyote, a rival buck, and something many miles away which I could not locate even through eight-power binoculars (Plates IX, XI, XII, and XIII).

BATTLING BIGHORNS CRASH HEAD ON

During the time we were following antelope, the first snow fell in the valleys, warning us that we must hurry to higher mountain ranges if we were to photograph bighorn sheep before winter set in. These statuesque creatures, which we stalked from Colorado to Canada, are more difficult to photograph than moose or buffalo.

A VETERAN NATURALIST TESTS MRS. CHAPMAN'S OUTDOOR COOKING

Vernon Bailey (right), retired Field Chief of the U. S. Biological Survey, and an expert woodsman, joins the authors in the Mogollon Mountains of New Mexico.

Not only are they few in number, but wary and agile in rough country.

Early on a crisp morning in the southern Montana mountains we scrambled up a rocky ravine to a slope where we had seen sheep through binoculars. Glaciated boulders nestling in crumbling banks rolled treacherously from under our feet and went bounding down as we clambered to the top.

Suddenly we were halted by an explosive whack. What could it be? Cautiously we crawled up behind a juniper bush and looked through its fragrant branches. On a sloping meadow 50 feet beyond, several old bighorn rams stood stiffly, heads back, eyes glassily gazing into the distance. Our noisy ascent had not alarmed them, for they were accustomed to hearing rocks falling from the crags. Half a dozen rams stood in a circle.

A pair of 300-pound rivals squared off twenty feet apart. Chins tucked under, horns lowered, through the air they hurtled, hitting in a head-on crash with all feet off the ground. The cliffs echoed. Down the pair dropped, balancing on their knees and slowly swaying their heads.

Half a minute they remained dazed, then staggered to their feet and resumed the fight. Again and again they crashed. Chips splintered from their horns. Fluted surfaces of the hitting arcs were hammered smooth (Color Plate XXIV).

BATTERING RAMS TEAM UP ON THE LOSERS

After a dozen crashes one ram weakened. He could hardly stagger to his feet. When he squared off for another battering, a strange thing happened. From the spectator rams a fresh one cut in to jolt the groggy battler. He took the count. Barely able to hobble, he dragged himself off a few paces where, sick and dazed, he lay down.

With him out of the fight, winner and recruit went at it until one of them weakened. Then another fresh ram cut in. More recruits continued the dueling.

Although the rams teamed up on the loser, they did not touch him when he gave up and turned away. This spirit of fair play was maintained only during the pre-mating battles. Once a ewe was at stake, each ram did his utmost to put rivals out of the running by fair means or foul.

We saw a fine ram dying from internal injuries received when he was butted over a cliff. Another, bumped off a ledge into the top of a juniper, was fatally impaled on a snag. A third died of concussion, a post-mortem showing that his skull had been split open between the horns.

Falling rocks and treacherous footing make bighorn sheep dangerous to follow. I was trailing a flock along a ledge, still camera in one hand, motion-picture camera on tripod in the other, when slowly my hobnails began to slip down the frosty rock. Not a crack, bush, or nubbin could I grab.

Quickly I dropped face downward, hoping trousers and coat would set up friction enough to check me. But down I slipped, slowly, irresistibly. A sheer precipice fell away below me. Closer and closer I was drawn to the brink.

Cautiously I let go of the still camera, grasped movie tripod in both hands, jabbed its legs into the frosty ledge. They held! I inched my way back to safe footing.

I would not have attempted to cross such treacherous rocks had not the flock of rams, ewes, and lambs stepped daintily across that very ledge a few minutes before.

Some of the ewes, lambs, and younger rams we approached by talking and by bleating like lambs. In taking natural-color pictures we found that such tactics worked with them (Color Plates XVII to XXIV), but every morning when we appeared on the range the mature rams went over the mountain and, if we tried to trail them, kept on over the next and the next.

A LAMB OUTWITS A COYOTE

The sentinel on duty, always a ewe, spied us before we saw the flock and watched while we puffed and perspired up the cliffs. So long as we did not talk or whistle while approaching under cover, the boulders which leaped and rattled from beneath our feet did not alarm the sheep. They seemed to rely largely on sight to apprehend enemies.

One cloudy day, as we watched a flock grazing on a rocky slope, a big mountain coyote slipped up under cover of a ridge. Barely a hundred feet away, he charged. The sentinel stamped her foot. At the signal, the entire flock dashed for the nearest crags, half a mile away.

Neck ruffled, the coyote stretched out for the hindmost lamb, jaws opened expectantly. But the lamb wheeled, sprang up the slope, and circled the pursuer.

Round and round in ever-widening circles they raced, cloven hoofs holding firmly on the rocky slope, padded paws slipping and skidding on rolling pebbles. Gradually the pursuer fell behind. With a final spurt the lamb dashed away to rejoin the disappearing flock. The panting coyote stopped, looked about, and gave up.

HOME TO THE SNUG TRAILER

Winter came suddenly to the bighorn range. Sun had shone feebly in the morning, but by afternoon snow beat cold in our faces, laid damp hands on our thinly clad bodies, and soaked our shoes. As we trekked along in the dusk it was comforting to stumble upon the tent, now hovering white beside the car in the glen. Inside, the gasoline lantern and stove soon sent their warm glow over us as we filled the tea kettle. By the time we dug out dry socks and clothes from the dunnage bags the water was boiling.

Not until the storm cleared did we dig ourselves out of the drifts and break camp. Over whitened trails we slipped and slid down the mountains to the trailer (p. 115).

"At home," taking advantage of the bad weather, we spent several days developing negatives in the darkened kitchenette. We hung them in the living room where heat from gasoline lanterns and stove dried them quickly.

Brilliant sunshine followed with days of ideal light. Before the storm the sheep migrated to their lower winter range and there we found them. When the passes over the mountains of Wyoming and Idaho were opened, we put chains on the car, hitched on the snow-decked trailer, and crept back to civilization on icy roads.

INDEX FOR JANUARY–JUNE, 1939, VOLUME READY

Index for Volume LXXV (January–June, 1939) of the National Geographic Magazine will be mailed upon request to members who bind their copies as works of reference.

© National Geographic Society Kodachrome by Wendell Chapman

MOTHER KEEPS HER EYES ON A FAR-OFF WOLF AS BABY NAPS IN THE SNOW

Heavy drifts in winter force Rocky Mountain bighorn sheep from their lofty crags down to lower levels. Here they are constantly threatened by coyotes, wolves, and mountain lions. Because of their excellent vision, sheep can detect an enemy from three to five miles away. The distant prowler has not alarmed the mother enough to make her arouse the youngster.

© National Geographic Society

Kodachrome by Wendell Chapman

ON SUCH RUGGED SLOPES, SURE-FOOTED ROCKY MOUNTAIN SHEEP CAN OUTMANEUVER WOLVES AND COYOTES

Bighorns dash up seemingly impossible cliffs, where a misstep would mean death, when they retreat from an enemy. Although these ewes and lambs, on summer range at the timber line, have strayed away from the crags, they can escape by running in circles. Their hoofs gouge into the sliding earth or grip the rocks, while the pursuer paws and slips and eventually falls far behind.

© National Geographic Society

Kodachrome by Wendell Chapman

ON THEIR SUMMER RANGE IN THE MONTANA ROCKIES, BIGHORN EWES AND LAMBS ACCEPT THE AUTHOR AS A FRIEND

Always a sentinel watches for enemies. After Mr. Chapman had been in their vicinity for several days, the flock became accustomed to him, much as they would to such harmless neighbors as elk, goats, and smaller animals. Bighorn sheep eat nearly any plant that grows within their domain. In winter they paw through the snow to uncover grass and brush (Plate XXII).

© National Geographic Society

Kodachrome by Wendell Chapman

TOO YOUNG TO FIGHT, TOO OLD TO STAY WITH THE "WOMENFOLKS," ADOLESCENT RAMS FORM THEIR OWN GANGS

Mature rams leave ewes and lambs to shift for themselves except in the mating season. The big fellows graze far from the flock in a select club, to which these two- and three-year-olds are not strong enough to gain admittance. White rumps and hind legs of bighorns resemble skintight pantaloons and are conspicuous at a short distance. When a few hundred yards away, the "pants" are a perfect camouflage on snow-covered, bush-dotted slopes or crags.

© National Geographic Society

Kodachrome by Wendell Chapman

FUZZY "EAR MUFFS," SUPPLIED BY MOTHER NATURE, PROTECT BABY BIGHORN FROM FROSTBITE WHEN COLD WINDS BLOW

Awaking from his nap (Plate XVII), the lamb became perturbed when he could not see his mother. He ignored the camera and photographer, but was fearful because he was alone, out in the open, half a mile from the cliffs. He began to bleat in a low, pleading manner, but was soon reassured. The ewe had merely wandered into a near-by swale. The six-months old lamb is almost as tall as his mother.

© National Geographic Society

Kodachrome by Wendell Chapman

PROTECTED AT LAST, THESE REMNANTS OF ONCE MIGHTY FLOCKS OF BIGHORNS DWELL IN REMOTE BACK COUNTRY

Mountain sheep were so plentiful from New Mexico to Canada that many Indian tribes lived on their flesh. Ruthless slaughter and long winters spent in sparse feeding areas brought the flocks to the verge of extinction.

© National Geographic Society

Kodachrome by Wendell Chapman

ALTHOUGH THE AUTHOR SHOUTED AND DANCED, THIS FRIENDLY FLOCK KEPT ON GRAZING IN THE SNOW

Only a lamb (right) paid any attention to Mr. Chapman's antics, which were intended to persuade the bighorns to pose alertly before the camera. Even the sentinel ewe (left) refused to become perturbed; she gazed off into the distance instead. Had the author rushed at the flock or threatened to harm them, the sheep would have fled, but that would have ended the patiently built friendship, and picturemaking as well.

CRINKLED HORNS OF A TWO-YEAR-OLD ARE NO MATCH FOR A BATTERING RAM

After the first year's rapid growth, the horns increase in length an inch or two each year. Mature rams engage in terrific butting duels. Taking positions about 20 feet apart, they rush each other furiously, meeting with violent and resounding impact.

© National Geographic Society

Kodachromes by Wendell Chapman

THE BIGHORN'S WINTER COAT THICKLY INSULATES HIS BODY

Although mountain sheep may lie in the snow for hours, pressed-down flakes do not melt. The matted hair effectively prevents escape of body heat.

MY FOUR ANTARCTIC EXPEDITIONS

Explorations of 1933-39 Have Stricken Vast Areas from the Realm of the Unknown

By Lincoln Ellsworth

AFTER embarking on four Antarctic expeditions, I have no hesitancy in putting down the last one, from which I have just returned, as the longest and hardest I have ever been on.

While I was cooped up in a tiny cabin just big enough to hold a bunk, a wash-stand, and a three-tier bookshelf, with no opportunity for any exercise, not even a bath, my good ship the *Wyatt Earp* wallowed and rocked in the trough of one of the wickedest oceans in the world—the Indian.

Sixty-five days passed after we left Capetown before we sighted the great ice barrier of the Antarctic Continent. Of this total of 65 days, 45 were spent in getting through the heavy pack ice. For 13 days at one time the propeller never turned, while we awaited a favorable wind to loosen the pack which held us prisoners.

It must have been an exceptional ice year, for during these 45 days we passed through pack ice extending a distance of 813 miles north and south, and much of it was heavy two-year-old ice.

Such a voyage with its delays wears nerves down considerably, especially when one realizes that an Antarctic summer is but two months long, and that time for flying is only a small fraction of the summer.

By the time we got through the pack, we were three weeks too late to attempt the flight I cherished—2,000 miles across the continent to the Bay of Whales—but we did explore from the air, and claim for the United States, an area almost the size of Nebraska.

ANTARCTICA IS TWO-THIRDS AS BIG AS NORTH AMERICA

Four expeditions, all told, at a total cost of $400,000—such was the debt incurred. But what about the profit?

Now, the sole purpose of all four expeditions was the exploration of the interior of this great southern continent (map, page 132).

"The highest object that human beings can set before themselves is not the pursuit of any such chimera as the annihilation of the unknown," said Huxley. "It is simply the unwearied endeavor to remove its boundaries a little farther from our little sphere of action."

A continent two-thirds the size of North America—was it mountainous, was it lowland, or was it high plateau?

Was it a single land-mass, or did a sea-level channel connect the deeply indenting Ross Sea on one side with the Weddell Sea on the other?

These were the problems that I wanted, if possible, to shed some light on.

BROKEN PLANE ENDED FIRST ATTEMPT

The object of my first expedition in 1933 was to fly across Antarctica from the Ross Sea to the Weddell Sea and return to my base ship in the Bay of Whales, a total distance of 2,900 miles.

After a voyage of 2,500 miles from New Zealand, we had no more than assembled the plane on the frozen bay before the ice broke up and the plane was so badly damaged we had to return it to America for repairs.

Meanwhile it was decided to winter the base ship, *Wyatt Earp,* in New Zealand pending a decision for the following year. I finally decided to make a one-way flight from the opposite direction; that is, from the Weddell Sea to the Ross Sea, and to camp at the Bay of Whales until the *Wyatt Earp* could come around and pick us up about a month later.* So the following spring we made the long journey across the South Pacific to Snow Hill Island, one of the three ice-free islands in the Weddell Sea.

But again we were frustrated and never had a chance to get started, for during the three months we waited we had no suitable weather in which to make a trans-Antarctic flight—only an unbroken period of snow squalls and winds.

We had to realize that flying weather in

* See "My Flight Across Antarctica," by Lincoln Ellsworth, in the National Geographic Magazine for July, 1936; "Exploring the Ice Age in Antarctica," by Rear Admiral Richard Evelyn Byrd, October, 1935; and "Conquest of Antarctica by Air," by Admiral Byrd, August, 1930.

Photograph by Lincoln Ellsworth

THE "WYATT EARP," VETERAN OF FOUR ANTARCTIC VOYAGES, MOORS TO THE SNOW-COVERED FLYING FIELD

Both airplanes can be seen on board, the small scouting plane over the ship's stern, and the large plane, in which the overland flight was made, amidship. The ice field was snow-covered "bay ice," its edge still frozen fast to the continental ice barrier.

the Antarctic may occur only one day a month, and this fact, together with the difficulty of finding a take-off field, piles up the odds heavily against an explorer who wishes to make use of airplanes in these inhospitable regions.

SIGNIFICANT FOSSILS FOUND ON SECOND EXPEDITION

But we did put in our time to advantage, for we found, upon the ice-free islands where we lay, an abundance of fossils, including petrified logs of trees belonging to the Sequoia family. I brought back to the United States for study 50 pounds of such fossils. They show that in Cretaceous times, when all this life and vegetation flourished—one hundred million years ago—Antarctica had a climate about like that of California today.

Think of America today, with its fertile valleys, giant forests, and accessible wealth in oil and minerals beneath the soil. Then picture it thirty thousand years ago; for it was then in the throes of an ice age, just as Antarctica is today, and with an ice cap hundreds of feet thick covering much of North America. Is there any reason to believe that Antarctica, a continent two-thirds the size of North America, does not contain similar wealth?

Only 400 miles from the South Pole, on the west side of the huge Beardmore Glacier, Shackleton found, along the exposed walls of sandstone and shale, coal seams which extend for 100 miles and which in some places are forty feet thick. Fossil impressions of fern leaves were recovered there later, together with the petrified stem of a prehistoric plant which measured eighteen inches in diameter.

Of course, it was only much-weathered lignite that Shackleton found, but it was coal nevertheless. And perhaps this presence of coal may indicate that petroleum, too, underlies the ice and snow of the Pacific side of Antarctica.

Once, in southern California, I picked up a small piece of quartz intersected with a narrow vein of gold. Back at the hotel where I was staying, everyone exclaimed, "What is it worth?"

"You miss the point," I replied. "The interest lies in the fact that there *is* gold somewhere along this coast."

After the second expedition I wintered my ship in South America, for it seemed likely that the Weddell Sea side that year

Photograph by Lincoln Ellsworth

MAKING READY FOR THE OVERLAND FLIGHT TO THE SOUTH

Having arrived late because of heavy pack ice, the crew rushes preparations in a race against the thawing weather of summer.

would be the best side from which to attempt the crossing, and I was determined to make it.

Nineteen thirty-five was my lucky year, for en route again to Snow Hill Island we saw another isle, Dundee Island, 100 miles farther north; and I doubt if a better take-off field could be found in Antarctica.

We were only a week getting ready before my pilot, Herbert Hollick-Kenyon, and I took off, in perfect weather. We started upon what we thought was to be a 16-hour flight; but, with our stops, it really took us just 22 days to make the 2,300 miles that separate Dundee Island from the Bay of Whales.

VAST TERRITORY CLAIMED FOR U. S.

Flying for a thousand miles over majestic mountain peaks rising 12,000 feet above sea level and never before seen by human eye, we were looking down upon the backbone of the Antarctic Continent and the onetime continuation of the Andes of South America, now broken by a gap of 500 miles of sea south of Cape Horn. Across this is the nearest approach to Antarctica, and a more turbulent stretch of ocean it would be difficult to find.

The 350,000 square miles of territory we flew over, comprising the area included between the meridians of 80 and 120 degrees west longitude, I claimed for my country, the United States of America.

We came down 16 miles short of our goal, but, strange to say, had to walk about a hundred miles to find Little America.

It was a happy and contented month that Kenyon and I spent alone there. The tension of 22 days was over. We had done our job. The blizzard camp of nine days with our goal still 600 miles away, the one-hundred-mile man-haul after our fuel had given out, were memories of the past as we settled down to a daily routine in our tiny shack fifteen feet under the snow, there to await the arrival of the ship—whenever that might be.

Ours had been the realization that we two were the only human beings upon a continent two-thirds the size of North America. Perhaps that thought brought us closer together. Anyway, we were glad of the four walls that shut out the fog-bound waste of endless white over which we had so long been traveling.

It was a glorious surprise when a parachute with provisions was dropped upon us during the night of January 15. It was from Lieutenant L. C. Hill, commander of the British Royal Antarctic Research Society

Drawn by Albert H. Bumstead

ELLSWORTH LOOKED DOWN ON A SECTION OF ANTARCTICA NEVER BEFORE SEEN

American Highland, flown over by Ellsworth and claimed by him for the United States, is on the Indian Ocean side of Antarctica in a region previously unexplored. After finding a snow-covered flying field at the rim of the continent, longitude 79 east, he made his flight south, on January 11, to a point about 240 miles inland and return. The map also shows Ellsworth's flight of November, 1935, from Dundee Island to the Bay of Whales, and a new claim by Germany as a result of an aerial survey conducted in 1939 from the catapult ship *Schwabenland*.

© The "Sydney Morning Herald"

THREE OUTSTANDING ANTARCTIC EXPLORERS "TALK SHOP" IN SYDNEY, AUSTRALIA

Sir Douglas Mawson (left) has led two expeditions to the Antarctic Continent along the Indian Ocean side. Sir Hubert Wilkins (right), who accompanied Lincoln Ellsworth (center) on his two latest voyages, made remarkable aerial surveys over Palmer Land in 1928, 1929, and 1930.

Photograph from Lincoln Ellsworth

OLD ROCKS, RICH IN MINERALS, MAKE UP THE INDIAN OCEAN SIDE OF ANTARCTICA

Probably pre-Cambrian in origin, the granites, gneisses, and schists found here are among the oldest rocks on earth. Much younger are the sedimentary formations Ellsworth noted on Snow Hill Island in Palmer Land. He brought back from Princess Elizabeth Land 50 pounds of samples containing iron, copper, and nickel (pages 137 and 138).

Photograph by Lincoln Ellsworth

LAND HO! THE BARRIER AND PRINCESS ELIZABETH LAND LOOM UP AT LAST

After fighting its way through pack ice for 65 days, the *Wyatt Earp* emerged into open water and soon sighted the southern continent dead ahead. Rocky land is emerging from the white covering in the center and at the left lie ice-free islands that have been smoothed by glacial action (page 137). The sudden rise of the ice sheet from its clifflike edge, called the barrier, to an estimated 1,500 feet is in striking contrast to the Pacific coast of Antarctica where the Ross Shelf Ice rises gradually for a distance of several hundred miles from its face.

Photograph from Lincoln Ellsworth

ELLSWORTH VIEWS A MASS MEETING OF ADÉLIE PENGUINS OF PRINCESS ELIZABETH LAND

Many of the islands were crowded with thousands of the "little old gentlemen with starched shirts and swallow-tailed coats." The birds' wings, useless for flight, have developed into swimming flippers. The nests on shore are piles of loose stones. Only two rookeries of the larger emperor penguins were found.

Photograph from Lincoln Ellsworth

THEY EXPLORED A VAST AREA NEVER BEFORE SEEN BY HUMAN EYE

J. H. Lymburner, pilot, and Lincoln Ellsworth, beside their ski-equipped plane on the bay ice of Princess Elizabeth Land just before the take-off.

ship, *Discovery II*, and we shall be forever grateful to the Australian Commonwealth for its thoughtful aid in our behalf.

PROVED POSSIBILITY OF LANDING AND TAKING OFF IN THE ANTARCTIC

Doubtless the greatest contribution derived from the flight was the fact that we landed five times during the crossing because of weather and took off again without difficulty. This points to the possibilities, in the future, of exploring the interior of this great continent by means of the airplane. Landings can be made and bases established from which to carry on detailed geological and other investigations of the surrounding territory.

After two years, in 1938, I again felt a longing to return south, this time to the Indian Ocean side of the Antarctic.

The long journey of 65 days from Capetown, and the consequent change in our plans, I have already mentioned (page 129). In fact, we were lucky to be able to make any flight at all, for mid-January is midsummer in the Antarctic and time was growing short.

During our voyage along the coast looking for a place from which to take off, J. H. Lymburner, from the small scout plane, spotted what was, perhaps, the only ice available.

The land-fast bay ice was soft and was breaking away from the shore. We faced the danger of the plane breaking through when landing it from the ship, where it was assembled, onto the ice. We wondered, even while taking off, whether it would hold. As the plane gathered momentum the danger lessened, until finally we were in the air. Rising to 1,500 feet, we cleared the barrier and headed due south.

TOOK PIPE—BUT NO TOBACCO

We carried in the plane emergency rations for five weeks, allowing 34 ounces per day per man. It's amusing—afterwards—to recall the incident of the tobacco. All of it to be included in the emergency list I had in my cabin before the plane was loaded. I very carefully pocketed my pipe before starting, and to my surprise, when I returned, there, still in my cabin, was the tobacco!

Once clear of the barrier, I was prepared

Photograph by Lincoln Ellsworth

SMOOTH-SURFACED ISLANDS INDICATE THAT THE ANTARCTIC ICE SHEET HAS RECEDED

Off the coast of Princess Elizabeth Land lie glaciated islands of exposed rock, scarred by ice that has receded. The region was named in honor of the heir presumptive to the British throne by Sir Douglas Mawson, who explored it in 1931.

to see a rugged topography with great mountain ranges to the south. But I was surprised and impressed by the vast wind-riffled desert of unblemished white that greeted my eyes. South, east, and west it stretched to the cloudless, blue horizon.

AREA NAMED "AMERICAN HIGHLAND"

We were cruising 135 miles an hour at an altitude of 11,500 feet. The temperature was minus three degrees Fahrenheit, but we were not cold. From our altimeter we estimated the surface below to be 7,500 feet above sea level. Apparently the surface rose steadily to the south, where, we assumed, it would attain the elevation of the great Polar Plateau, 8,500 feet above sea level, upon which lies the South Pole.

The total area claimed by us is 288 miles north and south by 300 miles east and west, with a rounded southern end, a total of 77,000 square miles (map, page 132). I named it "American Highland."

At latitude 72 south I dropped a copper tube, 8½ inches deep by 2½ inches in diameter, from the opened door of the plane; it struck the wing and bounced off onto the surface below. In the tube was a document worded as follows:

TO WHOM IT MAY CONCERN

HAVING FLOWN ON A DIRECT COURSE FROM LATITUDE 68.30 SOUTH LONGITUDE 79 EAST TO LATITUDE 72 SOUTH LONGITUDE 79 EAST I DROP THIS RECORD TOGETHER WITH THE FLAG OF THE UNITED STATES OF AMERICA AND CLAIM FOR MY COUNTRY, SO FAR AS THIS ACT ALLOWS, THE AREA SOUTH OF LATITUDE 70 AND TO A DISTANCE OF 150 MILES EAST AND 150 MILES WEST OF MY LINE OF FLIGHT AND TO A DISTANCE OF 150 MILES SOUTH OF LATITUDE 72 LONGITUDE 79 EAST WHICH I CLAIM TO HAVE EXPLORED.

DATE 11 JAN. 1939

(signed) LINCOLN ELLSWORTH.

I hated to turn back. I looked again upon the scene around me and thought how fiercely the gales must sometimes blow here, for at our elevation the riffles with a noticeable east and west trend must have been at least two feet from bottom to crest.

But now it was all so peaceful in the

© "The Mercury," Hobart, Australia

PORT AT LAST! "WYATT EARP" ENDS 86,000 MILES OF VOYAGING

Ellsworth's veteran ship arrives at Hobart, Tasmania, upon completion of her fourth journey into the Antarctic. She has been acquired since by the Australian Navy.

mellowing glow of a low westering sun—serene in its solitude, though no human eye sees nor human tongue speaks its beauty—and I thrilled to think that we two were the first mortals actually to see the interior of this side of Antarctica.

The great ice sheet is slowly receding. The score or more of ice-free islands lying off the barrier where we were, all heavily littered with glacial boulders, is but one evidence. We visited seven of them and found all heavily mineralized (page 133).

The rock, mostly, is a pink granite intermixed with gneiss and quartzite. It contains dikes of decomposed quartz studded with garnet, is heavily copper-stained, and carries wide bands of metalliferous ore of a purplish hue, the color of chilled steel. I found iron ore in quantity and also samples which undoubtedly contained nickel. I collected and brought back 50 pounds of specimens of these mineral-bearing rocks.

The contrast between the geology of the opposite sides of Antarctica is quite marked. While the Indian Ocean side from Enderby Land to Princess Elizabeth Land appears to be mostly pre-Cambrian—gneiss, granite, schist—the formations that I saw on the Pacific side are mostly of sedimentary origin.

Then, too, there is a marked difference in the topographical features of the two sides. There is much mountainous land on the Pacific side. From what I saw on the Indian Ocean side, however, the whole area appeared to be a featureless, unbroken white waste rising gradually from the barrier. At Princess Elizabeth Land it is 1,500 feet high and rises gradually toward the south. It is interesting to note that a party of Germans, on the Atlantic side, some 1,500 miles west of the region visited by me, apparently found the same vast ice fields rising toward the South Pole (p. 132).

And so, good fortune has permitted me the opportunity of a part in the unveiling of a continent for the last time in human history. My little 400-ton ship, *Wyatt Earp,* has voyaged more than three times around the world, covering 86,000 miles in quest of two flights.

Has it been worth while in the effort and money expended? My answer is unreservedly "Yes."

THE WORLD THAT RIMS THE NARROWING ATLANTIC

Latest Ten-color Map Supplement Shows Four Continents and New Transatlantic Air Routes Which Make This Ocean Only One Day Wide

By James M. Darley

National Geographic Society Research Cartographer

An extraordinary map which shows the Atlantic Ocean as a huge lake rimmed by the shores of four continents is presented to the 1,100,000 members of the National Geographic Society as a special supplement to the July number of their Magazine.*

Red lines of regularly scheduled air routes now span both North and South Atlantic and emphasize how greatly this ocean has shrunk as measured in the time it takes to cross it: a single day as compared to Columbus's 70 days.

American Clippers of the latest type—109-foot flying boats far bigger than the *Niña* or *Pinta*—can cross the Atlantic with passengers and mail in about one day by the northern route, via Botwood, Newfoundland, and Foynes, Ireland, or only a little longer by the southern route, via the Azores and Lisbon (page 141). British seaplanes soon will link Montreal with London.

The transoceanic air base at Foynes, on the River Shannon, with its powerful Rynanna Wireless Station equipped to give the flying boats bearings across the ocean, is just seventy miles northeast of Valentia Island, first landmark of Lindbergh on his epochal flight. What a contrast Rynanna makes with Lindbergh's circling over the fishing boat to ask, "Which way is Ireland?"

ALL OF SOUTH AMERICA SHOWN

From Dakar and Bathurst on the bulge of Africa, mail-carrying French and German planes make regular hops to the Brazilian coast in 14 hours. It is another flight of about 14 hours from Natal, Brazil, to Rio de Janeiro and 11½ hours more to Buenos Aires.

* Members wishing additional copies of the map, "The Atlantic Ocean," may obtain them by writing the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen. Outside of U. S. and Possessions, 75¢ on paper; $1 on linen. Postage prepaid.

This unusual map, loaded with information, brings out the true relationship between the Old World and the New.

Here on a single sheet of paper appear virtually all of Europe, with recent boundary changes; the United States west to the Rocky Mountains; the western shore of Africa; and the entire South American Continent. The area covered extends from the Arctic to the icy waters beyond Cape Horn.

The map spotlights South America, with its growing republics and busy cities, its rich trade resources and raw materials, its vast areas of undeveloped territory.

The earth's most often crossed ocean is shown in its entirety, with its winds, currents, deeps, limits of ice, and the broad expanse of the Sargasso Sea.

Red "NB" symbols indicate naval bases, and an inset ten times the scale of the main map portrays the Panama Canal, crossroad of commerce and cornerstone of continental defense. This vital waterway shortens the distance between United States Atlantic and Pacific coasts by 8,000 miles.

NEW MAP OF ANCIENT LINEAGE

Strangely, this ultramodern map is drawn on a projection devised more than 2,000 years ago. Unfold your map of the Atlantic and place your finger along the Equator to longitude 40° west. This is the point around which was constructed the framework of curving lines, each a segment of a true circle, that carries your latest National Geographic map. Used by Hipparchus, a Greek, who lived from about 160 to 125 B.C., this stereographic projection has been employed ever since, because of its ability to portray in their true shapes even those features in the remote corners of the map.

What with its Atlantic Clipper route, its new European boundaries, its new ports and railways only recently constructed, it can be truly said that this skeleton is here

draped with the most modern map its old bones have ever supported.

Carefully prepared in the cartographic studios of the National Geographic Society, the new map is drawn on a scale of 1:20,000,000, which means that 1 inch represents 20 million inches, or 316 miles, of the earth's surface. It recalls the map of the Pacific published as a supplement to THE GEOGRAPHIC for December, 1936. But it is a dissimilar twin, for while the Pacific is dotted with myriad islands, the Atlantic boasts but few that are genuinely oceanic.

Blue lines across the ocean are used to show strategic distances between the oceanic islands and the continents.

Ship routes have not been forgotten, for a table in the lower left-hand corner gives the shortest navigable distances between principal ports within the map area.

Deep-sea exploration, aided by sonic depth sounding, has gone on apace, and in 1939 the Hudson Canyon, a submarine extension of the river valley, was mapped in detail by the United States Coast and Geodetic Survey, 7,374 feet below sea level and only 100 miles from New York City.

With these submarine contour maps, a ship equipped with echo-sounding apparatus can determine its position even in pea-soup fog. As on land, the pattern of ridges and valleys is different throughout and each feature serves as an undersea landmark.

Ocean-floor topography is shown on the map by brown depth contours in meters.

THE ATLANTIC'S NEW "DEEPEST DEEP"

A + marks the Atlantic's new "deepest deep," the Milwaukee Depth, located in the Puerto Rico Trough at latitude 19° 36′ north, longitude 68° 20′ west. Here on February 14, 1939, while taking part in the Atlantic maneuvers, the U. S. S. *Milwaukee* made a sounding of 28,680 feet. The official announcement was made April 19, the day the Atlantic map was being sent to press. The near-by Dolphin Depth, formerly deepest, was promptly removed and the Milwaukee Depth was charted for the first time.

Corresponding roughly with the 100-fathom, or 200-meter, depth line of the map is the edge of the Continental Shelf. This shelf varies in width in different localities, extending out to sea for more than 250 miles southeast of Newfoundland and creating one of the world's most famous fishing grounds, the Grand Banks.

On the map Austria, Bohemia, Moravia, and Memel have been engulfed by Germany's green, while Slovakia sports a new spring color, symbol of her autonomy. Hungary has grown in size and now has a common border with Poland. Albania wears Italy's yellow.

While boundary changes in Central Europe have captured the headlines and the imagination, the Western Hemisphere has been quietly putting its house in order. A settlement of the Bolivia-Paraguay boundary dispute was recently announced and that new South American frontier appears on the Atlantic map along with the new European ones.

Notes in red show historic highlights of the sea. They begin with Hanno, Carthaginian navigator (500 B. C.) who sailed down the African coast to Cape Palmas, bringing back tales of burning heat and rivers of fire, and they continue on through twenty-five centuries to record the expedition of Dr. William Beebe with whom the National Geographic Society co-operated in exploring undersea life off Bermuda. A world record descent of 3,028 feet was made, August 15, 1934, and previously unknown submarine creatures were observed and recorded in color for readers of THE GEOGRAPHIC.*

LEGENDARY LAND FROM WHICH THE ATLANTIC TAKES ITS NAME

Four hundred years before the Christian era, Plato in the *Timaeus* wrote of the legendary island of Atlantis, supposed to have existed nine thousand years before his time beyond the Pillars of Hercules, as the promontories at the Strait of Gibraltar were then called.

It was believed to be larger than Asia and Africa combined and to have been swallowed up "in a single day and one fatal night" with great earthquakes and fearful inundations.

Another legendary island is that of St. Brendan, an Irish priest of the sixth century, who built the monastery at Clonfert and voyaged across the Atlantic in search of the "Promised Land of the Saints." With "the mighty intolerable ocean on every side," he spent a night on the back of a sea monster, passed a barren isle where Judas enjoyed each year a vacation from purgatory, and was then directed to his promised land by a hoary-headed hermit. This variously lo-

* See "A Half Mile Down," by William Beebe, in the NATIONAL GEOGRAPHIC MAGAZINE for December, 1934.

Photograph by Peter Killian

"YANKEE CLIPPER" WAS BUILT TO TAKE THE ATLANTIC IN A ONE-DAY STRIDE

Much longer than either the *Niña* or the *Pinta* of Columbus's day, the 109-foot double-decked, winged hotel, with a wing span of 152 feet, accommodates 74 passengers on short hops and will carry a maximum of about 35 on transatlantic flights. The 41½-ton flying boat, powered by four 1,500-horsepower motors, was christened by Mrs. Franklin D. Roosevelt in Washington on March 3. On May 20-21 the *Yankee Clipper* inaugurated regular air transport service between the United States and Europe, crossing the Atlantic via the Azores in just over 26½ hours.

cated island appeared on maps up to the eighteenth century.

But even in our century, islands have been charted and later removed from the maps. Thompson Island, formerly charted in 54° south and 4° east, has been searched for unsuccessfully by numerous survey vessels and is now considered not to exist.

Was an island ever there? Why was it charted? Herman Melville in *Moby Dick* gives a whaler's version, when he describes the floating carcass of a whale: "Espied by some timid man of war or blundering discovery-vessel from afar . . . the white mass floating in the sun, and the white spray heaving high against it: straightway the whale's unharming corpse, with trembling fingers, is set down in the log—shoals, rocks, and breakers hereabout: beware!"

SARGASSO SEA OF VAST EXTENT

Southeast of Bermuda is the Sargasso Sea, that legendary and fictional "Port of Missing Ships." It takes its name from a Portuguese word meaning seaweed. It is a sea without land features to demarcate it, being bounded only by ocean currents—by the Gulf Stream on the west and north, the Southeast Drift Current on the east, and the North Equatorial Current on the south.

Despite its lack of visible boundaries, it is definitely delimited by its peculiarities. Floating gulfweed, without roots and believed to be an adjustment of plant life to the environment of the open sea, is commonly found here in patches as large as a baseball diamond or infield, and areas up to an acre have been seen.

This weed area was met with and navigated by Columbus, who recorded it in the log of his first voyage. He had been warned by a Portuguese sailor that one of the chief difficulties to be encountered was the grasses, so there must have been some knowledge of its existence prior to 1492.

Despite these early legends and later novels, there is no proof that the weed ever seriously impeded the progress of a ship.

As defined on the Atlantic map, the Sargasso Sea covers two million square miles, or about two-thirds the area of the United

States. Its waters are deep blue in color and unusually transparent. In these two characteristics it even outranks the Gulf Stream. A 6½-foot disk, when lowered beneath its surface, was still visible at 217 feet.

Eels which inhabit not only the rivers of Europe and America but small brooks and ponds on both sides of the Atlantic converge on the Sargasso Sea each year to breed and then die.

BROWN ARROWS SHOW PREVAILING WINDS

Winds, once the most important factor in navigation, supplying the motive power for oceanic voyages, are shown on the map by brown arrows. Although supplanted by steam and motor, they are again of immense importance, for they are the very breath of the related sciences of aviation and meteorology.

Most constant of all winds are the trades, which blow for days and even weeks with no more than a slight variation in velocity or direction. The South Atlantic, along with the South Indian Ocean, is especially favored, for here the trade winds reach their greatest development. In still another way is the South Atlantic fortunate, for it is never invaded by tropical cyclonic storms. These storms originate only in the doldrums, north of the Equator, where the air is always hot and sultry and squalls are commonplace.

Other regions of light and variable winds are the horse latitudes, or calms of Cancer and Capricorn, where, in contrast to the doldrums, the air is clear and fresh.

MIGHTY RIVERS IN THE OCEAN

The prevailing westerly winds of the Temperate Zones blow in the Southern Hemisphere with a constancy second only to that of the trade winds. They have given the name "roaring forties" to the latitudes where they most regularly exhibit their turbulent temperament.

Ocean currents are shown on the map by blue arrows and of these the Gulf Stream is the most important. Like the other currents, it owes its origin principally to the winds. Breezes, through friction, set in motion the surface waters of the sea, and these in turn impart their motion to the next lower water layer, and so on until an ocean current is set up.

On the direction and force of the prevailing winds depend the strength and permanence of the currents. The Gulf Stream's velocity changes with the seasons along with the intensity of the trade winds, to which it is indebted for its origin.

Of a deep indigo-blue color so that its juncture with other waters is plainly evident, the Gulf Stream in its swift flow to the north cools so little that it is vastly warmer than the waters through which it passes. Tempering the climate of the north as it does, it is often called the "heating apparatus" of western Europe.

The Labrador Current flowing southward from Davis Strait passes along the Labrador and Newfoundland coasts and then skirts the eastern shoulder of the Grand Banks, bringing with it the ice found in this region during certain months.

It was here in latitude 41°46′ north, longitude 50°14′ west, that one of the greatest of all sea tragedies occurred, when the *Titanic*, largest ship then afloat, sank on her maiden voyage after striking an iceberg, April 14, 1912. This disaster led to the establishment of the International Ice Patrol. Conducted by the United States Coast Guard, its expenses are paid by 14 nations according to their shipping tonnage.

ICEBERGS FROM GREENLAND AND ANTARCTICA

Most of the North Atlantic bergs are launched by the glaciers of Greenland's west coast. In the south of Greenland a small but prolific glacier gives birth to the bluish-hued bergs so difficult to see at night.

But these Arctic icebergs are completely eclipsed by the much larger Antarctic ones with their longer life span. The northern bergs are seldom older than two years, while the southern bergs sometimes reach an age of ten years.

Shown by white shading in the blue tint, the "northern and southern limits of ice" exhibit some queer kinks. Most peculiar of these is the tongue of ice, south of Martin Vas and west of Tristan da Cunha, which is driven north from the Antarctic by the cold Cape Horn Current.

Such a map shows vividly how far to the east South America lies as compared to North America, and this is emphasized by the time zones, depicted by white lines. The time difference between London and Rio de Janeiro is only three hours, compared to five hours between London and New York. The *west* coast of South America is about as far east as Jacksonville, Florida.

VOL. LXXVI, No. 2 WASHINGTON AUGUST, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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IOWA, ABIDING PLACE OF PLENTY

The State Where the Tall Corn Grows Provides the Nation with a Tenth of Its Food Supply

BY LEO A. BORAH

"AND surely it floweth with milk and honey."

With a fourth of the grade A farm land in the United States, with soil yielding in some years more wealth than all the gold mines of the world, Iowa is a modern Promised Land.

It is first among the States in the production of corn, oats, hogs, and horses; in the number of fat corn-fed cattle; and in the total value of grain crops, of livestock, of poultry, and of all farm property and implements. As for "milk and honey" specifically, it ranks next to Minnesota in output of creamery butter and fourth among the States in quantity of honey produced.

A HUNDRED-MILE FURROW

Its incredibly fertile rolling prairies are so arable that in 1839 Lyman Dillon plowed with ox teams a single road-marking furrow from the newly established Territorial Capital at Iowa City to Dubuque, nearly a hundred miles! Of its 56,147 square miles —561 in lakes and streams and the rest in land—more than 96 per cent is in farms, of which almost three-fifths is under cultivation and about a third in pasture.

Not only does the State lead the Nation in crops and in percentage of land in farms; it is first also in literacy, with a record of 99.2 per cent. It is the only State west of the Mississippi River distinguished as the birthplace of a President. Herbert Hoover was born at West Branch (map, pp. 146-7).

To the United States Department of Agriculture Iowa has contributed four secretaries: James ("Tama Jim") Wilson, 1897-1913; Edwin T. Meredith, 1920-21; Henry C. Wallace, 1921-24; and Henry A. Wallace, 1933-. The State has produced Cabinet members besides these, but the agricultural leaders are mentioned as showing the prominence of Iowa in national farm affairs.

Statistics might go on and on, but to the native son long absent from his home State, Iowa means much more than a list of "firsts." There is greater reality for him in memory pictures of the scenes of his childhood. He has only to close his eyes to hear again the meadowlark singing its spring matutinal or the mourning dove its evensong; to catch the glint of an eastern goldfinch, oriole, dickcissel, or tanager flitting through the trees; to feel the hot road dust between his bare toes as he trudged toward the "crick" with fish pole on shoulder; to thresh noisily in the high-piled carpet of bright autumn leaves in search of nuts and scare up a covey of quail; to flounder schoolward knee-deep in snow whirled into wildly shifting drifts before a boisterous wind.

If he is a descendant of Iowa pioneers, he remembers how his youthful fancy peopled woodland shadows with stealthy savages conjured from his grandparents' stories of the Spirit Lake massacre (Plate X). The hostile Sioux, the poor Ioway, the

Photograph by J. Baylor Roberts

"IT'S YOUR MOVE, SON"

An old-timer registers satisfaction in the checker tournament at the State Fair in Des Moines. Thirty-one experts compete for the State championship, each playing two games with every opponent. A victory counts two points, a draw one; and the high score at the end of the week wins the prize.

friendly Sac and Fox, the wary Winnebago, the proud Potawatami—his imagination brought back all the vanished Indians and made of the quiet countryside a place of romantic adventure.

Vividly he envisages the cornfield steaming under a glaring sun after a rain, heat waves shimmering in the close air. With what rebellion in his soul he grasped his hoe and moved down the rows, hacking half-heartedly at "glory vines" and "pusley." Wild sweet williams in the wood lot were much more alluring than the "o'n'ry" weeds, but there was to be a Fourth of July celebration in town, and if he got the patch hoed in time he would have money to spend.

Of such homely things is the background of Iowa, for 60 per cent of the two and a half million people of the State live on farms or in small towns, and even the largest cities—there are 16 with populations greater than 15,000—are a part of the rural scene, deriving their prosperity and most of their dwellers from the farms.

It was with recollections such as these that I went back to Iowa after an absence, save for a few brief visits, of more than 20 years. Aboard the streamlined Rocket train, which speeds from Chicago to Des Moines in about six hours, I thought of the creeping caravans of prairie schooners bringing the first white settlers to the new land west of the Mississippi little more than a century ago.

Two streams of colonists, one from the North, the other from the South, poured into Iowa, there to mingle and form a society with traditions of both sections of the country. Many an Iowan has one parent of New England ancestry, the other sprung from Dixie.

In *Vandemark's Folly,* Herbert Quick, Iowa lawyer-novelist, described dramatically the early rush for land, when hundreds of covered wagons drawn by horses,

oxen, and even cows waited their turn to cross the ferries to McGregor, Dubuque, Clinton, Buffalo, Davenport, Muscatine, Burlington, Fort Madison, and Keokuk.

Many of the newcomers, always having lived in timber country, shunned the open prairies as worthless for farming, and established homesteads in wooded areas where they had to chop down trees and grub out stumps before they could plant crops!

From Rock Island, Illinois, my train rumbled across the Mississippi River to Davenport, first Iowa community to have railway service. In 1854, when a company began construction of a railroad bridge here, steamboat men, who called the river "a navigable waterway consecrated by Nature" for boat traffic, put up heated opposition. The structure was completed in 1856, however, and trains began to go through from Chicago to Iowa City, then the end of the line later extended to Council Bluffs.

Photograph by J. Baylor Roberts

12-INCH EARS OF HYBRID CORN ARE SYMBOLS OF PLENTY

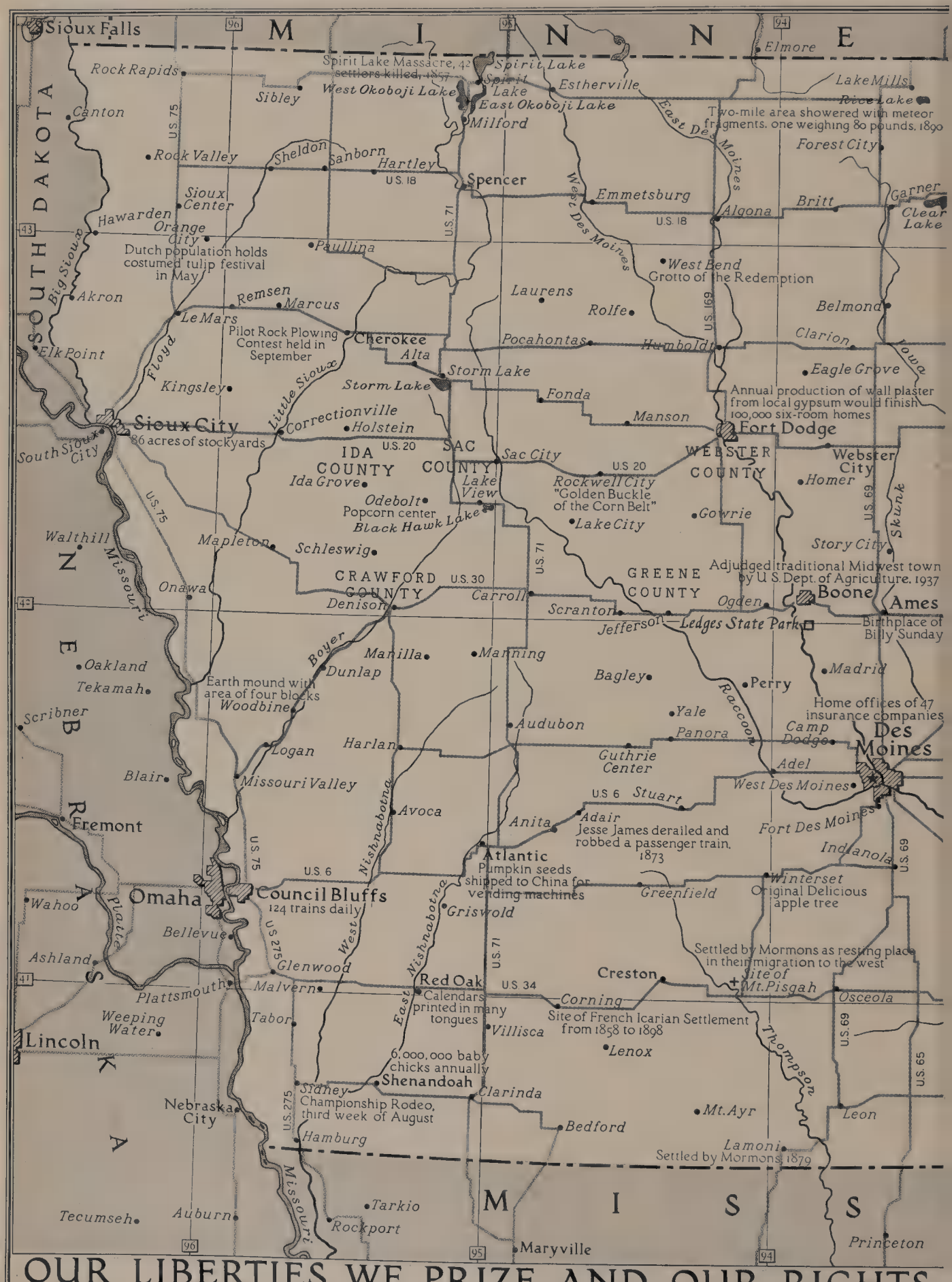
On this field of 105 acres near Bagley, Dr. J. A. Pringle will grow an average of 90 or more bushels to the acre, double the normal crop from ordinary seed (pages 150, 159, and Color Plates II and VIII).

LINCOLN AN IOWA LANDOWNER

When a St. Paul-bound steamer struck one of the piers, caught fire, and burned to the water line, the shipowners went to court with a damage suit and a plea that the railroads be required not only to remove the obstruction to river traffic but to refrain forever from bridging the Mississippi!

Among those representing the railroads at the trial in 1857 was Abraham Lincoln, then only a modestly successful lawyer. He had, as he had declaimed in a fun-poking speech in Congress in 1848, "fought, bled (from mosquito bites), and come away" in the Illinois Black Hawk War which had opened to white settlers in 1833 the strip of Iowa known as the Black Hawk Purchase, but he had never visited the State until his trip to Davenport to inspect the scene of the accident.

In recognition of his service as a captain of militia, he had been granted Tama County, Iowa, land which he never saw.



OUR LIBERTIES WE PRIZE AND OUR RIGHTS

HOGS · CATTLE · HORSES · MULES
IOWA
Twenty-ninth State
Admitted to the Union 1845
Population 2,552,000
Area 56,147 square miles
0 10 20 30 40
Statute Miles
CORN · OATS · POPCORN · BARLEY
Le Roy
Harmony
Upper Iowa
Northwood
Cresco
The Decorah "Posten", semi-weekly newspaper printed in Norwegian, circulates 31,000
Decorah
Lansing
Waukon
Manly
Osage
Antonin Dvořák composed here
Fort Atkinson State Park
Spillville
Calmar
Mason City
Produces annually enough cement for a transcontinental highway
New Hampton
Charles City
Fort Atkinson
Festina
Postville
Railroad crosses river on pontoons
St. Anthony's Chapel seats only 8 people
Marquette
Monona
Giard
McGregor
Ringling brothers played circus as children
Bradford
The Little Brown Church in the Vale
Nashua
West Union
Turkey
Fennimore
Dodgeville
Sheffield
Greene
Cedar
Shellrock
Wapsipinicon
Sumner
Fayette
Elkader
Guttenberg
Mineral Point
Lancaster
WISCONSIN
Clarksville
Waverly
Platteville
Hampton
Oelwein
Strawberry Point
Mississippi
Darlington
Cuba City
White Pine Hollow Preserve
Fairbank
Amish Mennonites; customs require chin whiskers but frown on mustaches and suspenders
Fox Indians permitted Julien Dubuque to mine lead, 1788
Shullsburg
Parkersburg
Iowa Falls
Pigeons nest in river cliffs
Cedar Falls
Waterloo
Dairy Cattle Congress meets in fall
Manchester
Dubuque
Independence
Dyersville
Catfish Creek
Galena
New Melleray Abbey
Trappist monks
Pine Lake State Park
Grundy Center
Herbert Quick, author of "Vandemark's Folly", attended school here
Eldora
Cascade
St. Donatus
Bellevue War between horse thieves and vigilantes, 1830's
Bellevue
Birthplace of Margaret Wilson and locale of her Pulitzer novel "The Able McLaughlins"
Traer
Plowed furrow marked the way from Iowa City to Dubuque, 1839
Monticello
Maquoketa Caves State Park
Andrew
Home of Ansel Briggs, Iowa's first Governor, 1846-1850
Vinton
TAMA COUNTY
LINN COUNTY
Anamosa
Maquoketa
State Center
Marshalltown
Keystone
Population one-third Czechs
Toledo
Tama
Cedar Rapids
Mt. Vernon
Lillian Russell's stage debut here, her birthplace
Clinton
Tama Indian Reservation
Belle Plaine
Purely communal life by German Amana Society, 1855 to 1932
Cedar
Founded by J. B. Grinnell at advice of Horace Greeley to "Go west, young man, go west"
Marengo
West High Middle East Amana
Amana
De Witt
Tipton
Buena Vista
Mitchellville
Colfax
Grinnell
Brooklyn
South Amana
Homestead
JOHNSON COUNTY
Birthplace of Herbert Hoover
West Branch
Boyhood home of Buffalo Bill
Le Claire
Bettendorf
Newton
"Washing Machine City" 7,500,000 since 1898
Williamsburg
Iowa City
Mormon handcart expedition left for Utah, 1856
Wilton
Davenport
Moline
Montezuma
West Liberty
Buffalo
Montpelier
Rock
Wild Cat Den State Park
Muscatine
"Button City"
Rock Island
Site of first Mississippi River bridge, 1850
New Sharon
Des Moines
Cups, saucers, teapots and pitchers made from local white clay
What Cheer
Pella
Costumed Dutch hold tulip festival in May
Keota
Iowa
Knoxville
Oskaloosa
Settled by Quakers, 1843
Musical Welch came to mine coal in 1870
Sigourney
Washington
Skunk
Aledo
Melcher
Wapello
Bridge of wagons gave access to mass meeting on south bank, Lincoln-Douglas campaign, 1860
Iowa Wesleyan, oldest college in State; daughter of one-time President Harlan married Robert T. Lincoln, son of the Emancipator
Keithsburg
Albia
Chariton
Ottumwa
Fairfield
Mt. Pleasant
Galesburg
WAPELLO COUNTY
Eldon
Libertyville
New London
Monmouth
"Hawk-Eye Gazette's" files go back to 1837; this paper is source of Iowa's nickname
Mississippi
Abingdon
Burlington
Corydon
Mystic
DAVIS COUNTY
Bloomfield
Government trading post, 1808-1813
Centerville
Moulton
Fort Madison
Dallas City
Seymour
Farmington
Site of Waterloo
La Harpe
Bushnell
Nauvoo
Encampments of Iowa and Missouri troops during bloodless "Honey War"
Macomb
Unionville
Memphis
Keokuk Dam
Colchester
Mark Twain set type for city's first directory
Keokuk
Francis Scott Key's decree in 1841 is basis for Keokuk land titles
Drawn by N.B. and R.E.M.
WE WILL MAINTAIN
THE HAWKEYE STATE

Photograph from Des Moines Register & Tribune

DUCKS DARKEN THE SKY OVER MISSISSIPPI VALLEY LOWLANDS

Lying as it does between two great rivers, Iowa abounds in mallards and other species, but partly because of increasing civilization in their breeding grounds, international protection is necessary to maintain the stock. In early days passenger pigeons were more numerous than wild fowl are today (page 176).

© Chicago Aerial Survey

SET IN A 70-ACRE PARK, THE GOLD-DOMED CAPITOL AT DES MOINES OVERLOOKS THE ENTIRE CITY AND THE VALLEYS OF TWO RIVERS

The State Historical, Memorial and Art Building rises in right foreground. At left is the tall Soldiers and Sailors Monument designed by Harriet A. Ketcham of Mount Pleasant. In the background the gray stone buildings of the Civic Center are grouped on both sides of the Des Moines River above its junction with the Raccoon (p. 150).

He neglected to file the warrant because he feared he would be too poor to pay the taxes. More than two years after his death, a second warrant, issued to him in 1860 by President James Buchanan, was recorded in Crawford County for title to a 120-acre tract near the site of the present town of Schleswig.

The Davenport bridge case was never settled, for the jury disagreed. However, rail traffic continued, building up trade for Chicago despite the grumbling of the rivermen.

THE CAPITAL A FARM CITY

It would be difficult to find a capital more typical of its State than Des Moines. Most of the 150,000 people are still close to the soil. Their talk is of crops and cattle, of farm prices and the weather.

Spread over the valley of the Des Moines and Raccoon Rivers, the city has the roominess of wide-open spaces. Hundreds of homes are set on lots large enough not only for wide lawns and flower beds but for kitchen gardens as well. A 60-acre cornfield is tilled within the corporate limits.

The gold-domed capitol, standing in a hilltop park, commands a view of the whole valley to the wooded horizons (page 149).

Four Milan arch bridges cross the river, which, flowing from north to south, bisects the city. It was down this stream in 1894 that "Kelly's Army" of nearly 1,000 unemployed men en route from Omaha to Washington to tell their troubles to President Cleveland floated to Keokuk in flatboats contributed by a populace eager to be rid of them.

Farther west is the main business district where in their home offices function most of the 47 insurance companies which make Des Moines the "Hartford of the West." There also are many publishing houses, printing nationally circulated farm and home magazines, fraternal and commercial papers, and other journals—57 regular publications in all.

The Des Moines Register, together with the *Tribune,* serves all Iowa, having 77,000 farm subscribers and going by carriers to some 45,000 farm homes each day. Its daily circulation numbers more than twice the total population of Des Moines, and it has the largest direct-mail delivery in the United States. How closely it is knit with Iowa is shown by the fact that only one per cent of its readers reside outside the State. Contrary to usual newspaper practice, its owners go after circulation primarily and let advertising follow.

Most of the manufacturing plants in Des Moines are in outlying areas well segregated from residential neighborhoods. Through the packing plants some of the Iowa corn crop "goes to market on the hoof," but meat packing is by no means the only industry. Hosiery; woolen goods; and fur, leather, foundry, grain, dairy, clay, and cement products are turned out by more than 400 factories. Several nationally known companies make cosmetics.

When I visited Iowa State College of Agriculture and Mechanic Arts at Ames, Dr. O. R. Sweeney, head of the Chemical Engineering Department, led me through laboratories where his assistants and students were turning cornstalks into paper, insulating material, and "wood," ranging from a substance softer than cork to boards harder and denser than teak and three times as strong as iron.

From oat hulls he makes furfural, an exceedingly cheap but satisfactory substitute for formaldehyde, and from corncobs, "mazolith," a corn stone that the layman cannot distinguish from marble. Soybeans, introduced into Iowa to build up the soil, and now an important crop, have been put to so many uses that the list staggers the imagination.

UNTOLD WEALTH FROM FARM WASTE

"In the United States," said Dr. Sweeney, "there are a billion tons of straw, stalks, hulls, shells, roots, and other agricultural by-products—the largest annual output of raw material in the world. Out of this despised stuff we can make almost any commodity we want, put our people to work, and perhaps solve the problem of farm economics."

Going about the campus, I realized ever more fully what remarkable service Iowa State College renders to the Commonwealth and how closely it is linked with agricultural interests. It maintains nine experimental farms in the State, and by scientific operation of them shows thousands of land tillers how best to cultivate and at the same time safeguard the soil.

Twenty years ago farmers depended for their seed corn upon the best ears selected from regular crops, and soft or inferior corn from one harvest meant a poor yield the next season. Nowadays they are using more

© National Geographic Society

Dufaycolor by J. Baylor Roberts

OUT OF WILDERNESS SPRANG THE OLD CAPITOL, PRIDE OF IOWA UNIVERSITY

The classic Administration Building crowns a low hill near the rock-walled Iowa River, which divides the campus at Iowa City. Erected in virgin forest nearly a century ago to house the Territorial Government, it became school property in 1857 when the State offices were removed to Des Moines.

© National Geographic Society

Dufaycolor by J. Baylor Roberts

IN ATHLETICS AS IN AGRICULTURE CORN STANDS FOR IOWA POWER

Students of the State University at Iowa City erected this monument in honor of the 1938 Home-coming and a Big Ten football game with Wisconsin. The idea recalled the Gay Nineties when Sioux City held annual festival in a domed and spired corn palace covered with the yellow ears.

© National Geographic Society

Dufaycolor by J. Baylor Roberts

A BIT OF OLD NORWAY HAS COME TO IOWA IN THE NORWEGIAN-AMERICAN MUSEUM AT DECORAH

On the Luther College campus descendants of the immigrants who began to come to the United States in 1850 have preserved relics of the culture of their homeland and of their pioneer days in Iowa. Center of the exhibits is a four-room home completely furnished with treasures brought from overseas.

© National Geographic Society

Dufaycolor by J. Baylor Roberts

FANCY BEEF CATTLE LIVE IN LUXURY ON PROSPEROUS IOWA FARMS

No expense is spared in the housing and fattening of blooded aristocrats of the livestock world; and there is keen rivalry among breeders, who constantly seek means of improving their herds. The perfectly kept "hip-roofed" barns and stables, and the tile silos on this short-horn ranch near Des Moines are typical of the best establishments in the State.

© National Geographic Society Dufaycolor by J. Baylor Roberts

A DUTCH MAID OFFERS DUTCH-MADE BOLOGNA

In Pella virtually all the people are of Netherland ancestry; shops specialize in bakery goods and in delicious, highly seasoned sausages prepared after treasured old-country recipes.

Kodachrome by J. Baylor Roberts

LITTLE CHESTER WHITE VOICES INDIGNATION

It is bad enough to be scrubbed and displayed at the Spencer Fair, largest county exposition in Iowa, but to be fondled by a girl is an insult that no pig can endure in silence.

© National Geographic Society

Kodachrome by J. Baylor Roberts

THUNDERING HOOFS BEAT OUT A MARTIAL CADENCE AT CAMP DODGE

During the World War this cantonment 12 miles north of Des Moines housed 40,000 soldiers in training. It is now used only for the summer encampment of the Iowa National Guard. At the Governor's Day Review, which is the climax of the annual program, the guardsmen conduct both cavalry and infantry maneuvers before a throng of spectators from all parts of the State.

© National Geographic Society

Kodachrome by J. Baylor Roberts

STEAMBOATING ON THE MISSISSIPPI HAS COME BACK IN SPLENDOR AT DUBUQUE

Through the lock of a roller dam built to raise the channel from the normal six feet to a nine-foot level, towboats push long trains of barges, laden with Iowa corn bound for New Orleans. The Federal Barge Line Terminal and Harbor, completed in 1928, about a mile below this point (right), has made inland Dubuque an important port for river traffic from late March until early November. The dam is one of 26 constructed across the river at strategic points to control the flow for navigation.

© National Geographic Society

Kodachrome by J. Baylor Roberts

GOLD OF THE FERTILE FIELDS IS POURED OUT IN CONSTANT STREAM

Wagonloads of corn hauled from Greene County farms keep this gigantic sheller humming throughout the husking season. At top speed it has a capacity of 2,000 bushels an hour.

and more seed from hybrid corn, the result of crossing the best strains in isolated fields.

No attempt is made to perpetuate this hybrid corn beyond the first season; a fresh supply is grown each year by commercial seed companies using methods developed on State College experimental farms. Its merits are that it is drought- and blight-resistant, and that it greatly increases acre production. Yields of 90 bushels to the acre—about double the amount from ordinary seed—are not unusual; and J. H. Greiner of Keota won the *Des Moines Register* and *Tribune* cup in 1938 by growing an average of 135.18 bushels to the acre on a 10-acre tract (page 145).

MORE CORN ON FEWER ACRES

In fields where the hybrid seed is grown, alternate rows of the chosen varieties are planted. As soon as the tassels appear, all those on plants of one kind are pulled off, those of the other sort permitted to develop. The pollen from the undisturbed tassels fertilizes the silk on the ear shoots of the denuded plants, and these produce seed containing in even balance the characteristics of both parents.

What hybrid corn means to Iowa is easily understood. If for any reason a farmer must let half of a field lie idle, he can offset some of the loss by planting the other half with the more productive seed!

When I was a boy in Odebolt, only the chief thoroughfares of the larger cities were paved, and small towns lost much of their farm trade in wet seasons. Well do I remember how our village streets would be cut into a jumble of wagon ruts and ridges during a January thaw and then frozen to such iron hardness that the pedestrian who wandered off a crossing felt the need of spiked boots and an alpenstock.

The Iowa State Highway Commission at Ames has banished such conditions. Today Iowa has more than 102,500 miles of good highways—nearly 6,000 miles paved, about 3,000 miles graveled, and the rest graded.

A Des Moines man and I motored about the entire State during several weeks following my visit to Ames.

Corn planting had been delayed by heavy rains, and few farmers were at work in the fields; but fine cattle and horses were browsing in green pastures, hundreds of little pigs were scampering about, and the whole countryside held joyous promise.

Most of the farmyards and feeding lots were as clear of litter as if they had been swept. While waiting to begin seeding, the owners had made everything tidy. I have seen places of far more spectacular beauty than the rolling prairie farms of Iowa, but nothing to surpass them in appearance of prosperity and contentment (Plate IV).

Near the coal-mining town of Colfax, we saw two men in uniform talking to the driver of a halted automobile.

"The police must have caught him speeding," I remarked.

"No," my companion replied, "he probably ran out of gas or had engine trouble, and those boys of the State Highway Safety Patrol are on hand to help him. There are 150 of them, all trained in a special school. If you violate a regulation, they'll warn you or report you; but they'll also give you emergency service, from supplying a gallon of gas to towing you to the nearest garage."

At Newton, "the city that washes the clothes of the world," factory smoke hangs over the rich farmlands. Here F. L. Maytag, a farm boy who had been a junior partner in a band cutter and self-feeder company, began in 1907 to make hand-power washing machines designed by Howard Snyder. Four years later the two men introduced electric motors to operate the machines, which soon were selling throughout the United States; and Mr. Maytag became the "Washing Machine King."

GRINNELL TOOK GREELEY'S ADVICE

It was to a New York Congregationalist minister, Josiah Bushnell Grinnell, that Horace Greeley gave the memorable advice, "Go west, young man, go west and grow up with the country." Grinnell and two friends followed instructions and in 1854 started the Iowa prairie settlement that became Grinnell. Ardent abolitionists, they maintained a station of the Underground Railroad in their log home.

They set aside land for a college campus and sold building lots with the stipulation that any on which liquor should ever be sold would revert to Grinnell or his estate. Grinnell College opened its doors in 1855, and in 1859 absorbed Iowa College, which had been founded eleven years earlier at Davenport by twelve Andover Theological Seminary graduates known as the "Iowa Band." Among Grinnell alumni are the writers James Norman Hall and Ruth Suckow, and the actor Gary Cooper.

Photograph by J. Baylor Roberts

WHAT A DIET OF IOWA CORN DOES TO A HOG!

This giant on a Sac County farm weighs 1,300 pounds, about six times as much as the correct weight for market nowadays. When feed was cheap and lard high, the animals were kept until they attained enormous proportions, but in recent years they go to the packers earlier. Of all the pork raised in the United States, the Hawkeye State produces 18 per cent.

We had driven little more than an hour eastward from the college city through typical Iowa countryside and cozy small towns when abruptly the scene changed and we found ourselves in a bit of the Old World, the home of the Amana Society. Here are West Amana, Upper and Lower South Amana, Middle Amana, High Amana, Homestead, East Amana, and Amana—seven exotic villages, established more than 75 years ago by German immigrants seeking freedom of worship.

They grow upon their own land walnut timber from which their skilled craftsmen fashion hand-carved furniture; sheep pastured in their fields supply wool for the distinctive blankets they weave on hand looms; their baked products, made of flour and meal ground in a venerable gristmill, are cooked in old-fashioned stone or brick ovens; and their smoked meats are from stock raised on their farms. Formerly they wore homespun clothing of uniform color, but now they dress in modern fashion.

Though a rapidly growing industrial center of nearly 60,000 population, Cedar Rapids impresses the visitor as primarily a home and college city.

The Civic Center, comprising a seven-story World War Memorial building and municipal auditorium and the Linn County Courthouse, is on a walled and landscaped island in the channel of the Cedar River. Until 1851 this island was the rendezvous of the Shepherd gang, troublesome squatters who were "persuaded to sell out their rights" for $7.50. The city paid $105,000 for it little more than a half century later.

Coe, a distinguished liberal arts college, is the largest of four coeducational schools established in Iowa by the Presbyterian Church. Others are Parsons College at Fairfield, Buena Vista at Storm Lake, and the University of Dubuque.

Christian colleges unselfishly devoted to the welfare of students of modest means

Photograph by A. M. Wettach

THOUGH IOWA IS TRACTOR-MINDED, THE MULE STILL HAS HIS PLACE

This sturdy colt, only three months old, shows by his size, build, light muzzle, and tufted ears that he is one of which his owner, Perl Spurgeons of Davis County, may be proud. The largest corn farm in Iowa, a 6,400-acre tract in Sac County, has elaborate machine equipment but is mule-operated except in emergency (page 179).

have played an important part in the development of Iowa. The Methodist Church has founded or assisted six: Iowa Wesleyan at Mount Pleasant; Cornell at Mount Vernon; Morningside at Sioux City; Upper Iowa at Fayette; Simpson at Indianola, and John Fletcher at University Park in Oskaloosa. Opened in 1844, Iowa Wesleyan is the oldest college in the State.

Columbia, for men, and Clarke, for women, in Dubuque and St. Ambrose in Davenport are Catholic colleges of excellent standing. At Pella is Central College, built by Baptists in 1853 but now under the auspices of the Dutch Reformed Church. The Society of Friends maintains William Penn College at Oskaloosa, the Disciples of Christ sponsored Drake University in Des Moines, the Lutheran Church has Luther College at Decorah, and the Evangelical Church conducts Western Union at Le Mars. Although now nonsectarian, Grinnell has a Congregationalist background.

Missionaries graduated from these schools have carried Iowa culture to the far places of the world, and there is hardly an outpost of civilization that has not felt the influence of earnest Christians from the "Bible Belt."

Grant Wood, Iowa artist best known for his *American Gothic* and *Dinner for Threshers,* has done much of his work in Cedar Rapids. In the dining room of our hotel we saw several of his murals, and in the Memorial Building a stained-glass window he designed. Thirty of his early canvases are permanently hung in the reception room of a mortuary at the rear of which is Turner Alley, the hayloft workshop where he painted them.

The Quaker Oats plant, one of the largest cereal mills in the world, has seven concrete elevators with a total storage capacity of 9,500,000 bushels. After being weighed, sorted, and cleaned, the oats are hulled, treated with violet rays, passed through steam chests, crushed to flakes by slowly

Photograph courtesy Des Moines Chamber of Commerce

MASSED BANDS PLAY THE CLOSING NUMBERS OF THE STATE HIGH SCHOOL MUSIC FESTIVAL

Each summer the University at Iowa City (Plate I) is host to more than 6,500 finalists from district high school music contests. These young people, representing some 550 schools, compete in solo and ensemble work, both instrumental and vocal. In May, Cornell College, in the little town of Mount Vernon, presents the Chicago Symphony Orchestra. Oskaloosa is the birthplace of the composers Frederic Knight Logan (*Missouri Waltz*) and Thurlow Lieurance (*By the Waters of Minnetonka*).

Photograph by J. Baylor Roberts

CATTLE FROM EIGHT STATES BAWL IN THE SIOUX CITY STOCKYARDS

From as far west as Montana, Wyoming, and Colorado, from the Dakotas, Nebraska, Minnesota, and Iowa, livestock rumbles by truck and train into this shipping center (page 181). Monday is the big selling time. Cowboys with Wild West lariats rope recalcitrant animals and "haze" them into the loading chutes. In the 86 acres of yards, reinforced concrete buildings with modern feeding, water, and cleaning facilities are provided.

turning rollers, and put up in packages. The hulls are used by a factory producing Dr. Sweeney's furfural (page 150).

IOWA CITY, THE FIRST CAPITAL

From Cedar Rapids we turned south to Iowa City, first capital of the State, and seat of the State University, which opened in 1855.

When the first Iowa territorial legislative assembly met in Burlington on January 21, 1839, it appointed three commissioners, one from each judicial district, to select a site in Johnson County for a new territorial capital. The founding act stipulated that at least two of these commissioners should be present at Napoleon, the county seat, not later than May 1, to agree on a site.

On the day appointed for the ceremony, only one commissioner was on hand. At noon he dispatched a messenger to bring in the nearer of the absentees, who lived 35 miles away. The 70-mile cross-country horseback race against time seemed hopeless. However, the second commissioner came in with his escort five minutes before midnight—by his colleague's watch!

A tract of 640 acres in a wild valley rising to a hilltop overlooking the Iowa River was selected, and the town was plotted. On this land was erected (1840-42) the Old Capitol, considered by critics the finest example of architecture in Iowa (Color Plate I). It was used as a statehouse from 1846 until 1857 when the government was removed to Des Moines. Since then it has been the University's Administration Building.

Like the State College at Ames, the University, with its nine colleges, serves all Iowa. An outstanding feature is the hospital, which under an act of the legislature is authorized to minister without charge to all sufferers in the State who are unable to pay for medical care. About 22,000 persons, the majority of them nonpaying, are treated every year.

In the University's history department I learned about the "Honey War," a boundary dispute between Missouri and Iowa that nearly resulted in bloodshed. A survey in 1816 had fixed as the northern boundary of Missouri the Sullivan Line, run to the "rapids of the River Des Moines." Iowans believed the statement referred to the Des Moines Rapids in the Mississippi; but in 1837 Missouri had a new line surveyed to some riffles in the Des Moines River about 13 miles farther north. If the new line was recognized, the area that was to become Iowa territory would be lessened by about 2,600 square miles.

Trouble was started in 1839, the year after Iowa became a territory, by a Missouri man who came into the disputed strip, cut down three bee trees, and carried the honey home. Since the settlers in those days depended on honey for "sweetenin'," this was a serious offense, and when a Missouri sheriff "added insult to injury" by twice trying to collect taxes north of the Sullivan Line, the Iowa Territorial Governor, Robert Lucas, ordered him arrested.

PITCHFORK ARMY IN "HONEY WAR"

The Missouri Governor promptly called out militia, and an army of more than a thousand assembled at Waterloo, Missouri. Nothing daunted, Governor Lucas summoned his forces to Farmington, Iowa. The 500 Iowa soldiers, who provided their own uniforms and weapons ranging from rifles to pitchforks, were probably as unmilitary looking as the Dutch army in Irving's *Knickerbocker's History of New York*. In one county the commander loaded five of his six supply wagons with whisky "to keep up the spirits of the men."

The armies, though "spoiling for a fight" and only a few miles apart, never came to blows, for both generals sent peace commissions to suggest friendly settlement.

Ten years later the Sullivan Line boundary was approved, and in 1851 it was marked plainly by a 200-mile row of iron stakes. Historians report that one woman who owned property in the "no man's land" expressed joy that her farm had not been put into Missouri, where she understood the climate was too poor for good crops.

At Iowa City met two constitutional conventions. Iowa refused statehood in 1844 because the people did not like parts of the proposed constitution, but accepted it in 1846, by a vote of 9,492 to 9,038, under a revision which was written in 15 days!

After a chat with "Steamboat Bill," a young member of the history faculty who is an authority on lore of the Mississippi, my companion and I drove down through the Honey War country to Keokuk to begin a trip beside "Old Man River" up the eastern border of Iowa.

Keokuk, named for the Indian orator whom the United States recognized as chief of the Sac tribe after the defeat of Black

Photograph by J. Baylor Roberts

"HE WAS NOTHING BUT A BIG FAKE"

In 1868 two enterprising young men bought a huge slab of gypsum at Fort Dodge, shipped it to Chicago, and engaged stonecutters to make of it a 3,000-pound "prehistoric man" ten feet long, two and a half feet wide. They sent it secretly to Cardiff, New York, where it was buried on a farm and later "discovered." Exhibited throughout the country, it attracted throngs and earned its exploiters a fortune. People believed it to be a relic of the days when giants roamed the earth; but Oliver Wendell Holmes exploded the theory by boring a hole into the solid "skull." Barnum's offer of $150,000 for the Cardiff Giant was refused. Today the "greatest hoax of the 19th century" reposes in the recreation room of the Des Moines home of Gardner Cowles, Jr.

Hawk, was the "Gate City" and outfitting point for early expeditions to the West and Northwest. Here once lived and worked Samuel Clemens, "Mark Twain."

The public library treasures a copy of the first city directory, most of which was hand-set by the humorist when he was working in his brother Orion Clemens' job printing shop. He listed himself as an antiquarian. On being questioned about this, he replied that every town should have one antiquarian, and since no one else was available, he volunteered for the position.

The Keokuk Dam, built into the hard limestone of the Mississippi River bed, backs up the Father of Waters nearly 65 miles to form a lake of 100 square miles. In a hydroelectric plant giant turbines generate 200,000 horsepower. It was a young army lieutenant, Robert E. Lee, who in 1837 first suggested obtaining power from the Des Moines Rapids of the Mississippi.

Fort Madison, which was established in 1808 as a Government trading post, was burned by its defenders five years later when it was about to be taken by Black Hawk and his warriors. The present city grew up around a chimney left standing after the fire.

On the spot where the old fort stood, we saw the six modern buildings of the W. A. Sheaffer Pen Plant, climax of a 20th-century industrial romance. W. A. Sheaffer, a young retail jeweler, began to manufacture fountain pens in the back room of his store in 1912. He was by no means the first to make fountain pens, but four years earlier he had hit upon an idea which was to revolutionize the trade. He had obtained a patent on the first practicable lever filler!

Up to that time fountain pens had been filled by medicine droppers. Money was subscribed by his friends and neighbors,

and the company started with $35,000 capital. Today, only 26 years from the date of its organization, the Sheaffer concern is the leader of the industry in the United States, with the largest dollar volume of business in this country.

Though the lever filler was the nucleus of the success, other innovations by Sheaffer helped it grow. Among these are the screw cap, which, when it replaced the old slip-type cap, was marked with the word "Turn" to warn the user against trying to pull it free. The propel-repel-expel pencil, "Skrip, Successor to Ink," the ball pocket clip which does not fray the clothing, and numerous other library supplies such as leads and "Para-Lastik" paste are now popular Sheaffer products.

BURLINGTON, OLD WISCONSIN CAPITAL

Before Iowa Territory was set apart, and while a capitol was being erected at Madison, Burlington was host to the second legislature of the Territory of Wisconsin. The building put up to house the assembly burned down, and Old Zion Church, the site of which is now occupied by a theater, became the legislative hall. Here also met the Iowa assemblies from 1838 to 1841.

Nowadays Burlington, attractively situated on four shady hills, is a railway and manufacturing center. Old Front Street, however, still retains the atmosphere of steamboat days, paddle-wheelers unloading produce of all sorts at the wharves.

For the *Hawk-Eye,* now the *Hawk-Eye Gazette* (established 1836), oldest Iowa newspaper in continuous publication, Bob Burdette began in the 1880's to write the sketches which brought him fame as a humorist. The paper's name, Hawk-Eye, became a nickname for citizens of the State.

Both Burlington and Muscatine, next important river city to the north, did a thriving lumber business in the latter half of the nineteenth century, timber being floated down to the sawmills from the north woods; but that trade is gone, the last raft of logs having passed in 1915.

Manufacture of pearl buttons from Mississippi River clam shells began to replace the lumber business in Muscatine about 1891 and grew so rapidly that two decades later the annual output exceeded 17 million gross. Because of the decrease of freshwater mussels, many of the button companies have moved away, but there are still 50 employing about 4,000 workers (p. 176).

Intimately associated with the city was the native son Ellis Parker Butler, author of *Pigs Is Pigs.* He said that when he came back to his home town after his first literary success and looked around for some memorial to himself, the only thing of the sort he could find was a large sign "I-C-E." This he interpreted to mean "In commemoration of Ellis." Thereafter the high school from which he was graduated was known as the I. C. E.

Through the gathering dusk of an April evening my companion and I drove out of Muscatine on the river road to Davenport. The Mississippi was quiet and mysterious as if "it must know somethin'" it would not tell about the days when it was the pulsing trade artery of a new world. Off to our left as we passed Montpelier lay the dark forest of pine and oak that is Wild Cat Den State Park, with its Steamboat Rock and other fantastic figures carved by wind and rain.

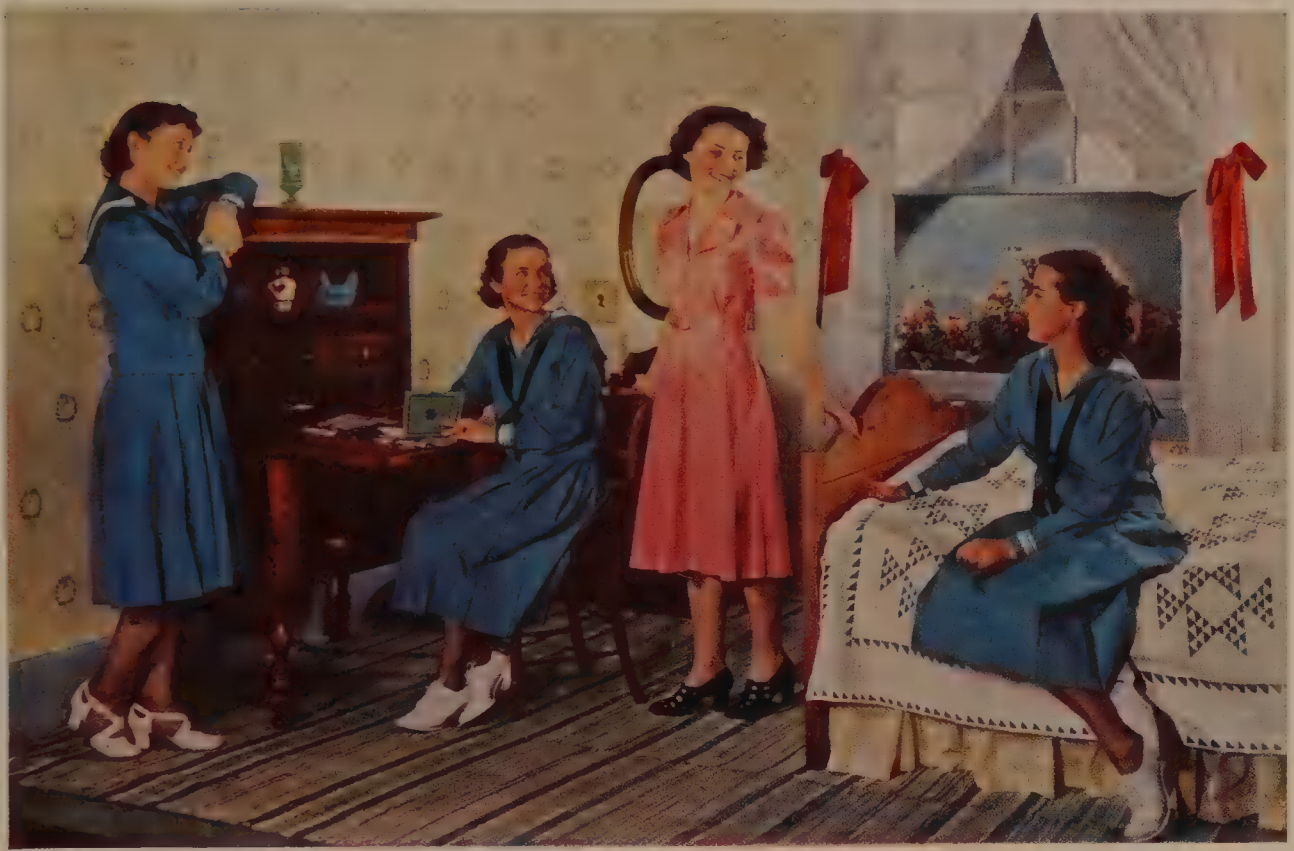
The moon swung clear of the trees on the Illinois side of the river, making a path of gold on the shimmering water. Far out in the shadows lights of two steamers twinkled, and I tried to visualize the racing stern-wheelers of Mark Twain's time, the wood fires under their risky boilers set roaring with oil, lard, or fat pork, and negroes perched on the safety cocks to press the last measure of speed from the precious steam. The Father of Waters still carries thousands of tons of freight, but the high adventures of old are only romantic memories.

Davenport, with a population of 61,000, largest of the Tri-City group which includes Rock Island and Moline, has a more metropolitan air than most other Iowa cities. It serves a vast Iowa agricultural area, however, and many of its finest homes, built on the high bluffs overlooking the Mississippi, are owned by retired farmers.

DRED SCOTT LIVED IN DAVENPORT

It was upon residence in a pre-emption shack in Davenport for his master, Dr. John Emerson, that the negro Dred Scott based his plea for freedom in the case considered by historians one of the important events leading to the Civil War; and on the Fourth of July, 1857, John Brown bought supplies here for the Kansas expedition that preceded his raid at Harpers Ferry.

Still standing is the home of one of the founders of the original settlement, Antoine Le Claire, the French half-breed whose



IOWA 4-H CLUBS SEND THEIR CHAMPIONS TO THE STATE FAIR AT DES MOINES

Misses "Heart," "Head," and "Health" show true feminine interest in the first prize dress designed and made by Miss "Hands." As their titles suggest, they are respectively winners of awards for personality, scholarship, physical fitness, and skill at household arts.

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Dufaycolors by J. Baylor Roberts

AT ORANGE CITY THE WOODEN SHOE MAKER IS KEPT BUSY

Netherlanders, who founded both this town and Pella (Color Plates V and XV), like to don old-country costumes for their annual tulip festivals.

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Dufaycolor by J. Baylor Roberts

SAILS FLUTTERING, BOATS ARE SET FOR A RACE WHERE STEALTHY SAVAGES ONCE PADDLED WAR CANOES

There is nothing nowadays at Gull Point, West Okoboji, to remind vacationers that the whole region of the 19 lakes in northwestern Iowa was once a place of terror; yet not far from this spot the renegade Sioux Inkpadutah and his treacherous band murdered 42 white settlers in the Spirit Lake Massacre of 1857.

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Kodachrome by J. Baylor Roberts

EXOTIC AS THE LOTUS THE CHILDREN GATHER ARE THE AMANA COMMUNITIES

German immigrants, living according to the tenets of a religious faith, have created in Iowa a bit of the Old World. When the traveler turns off the main highway to their seven quaint villages, he finds himself suddenly transported out of modern scenes into a medieval setting.

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SHENANDOAH RAISES FLOWERS, EVEN ON ITS LIGHT POSTS

Instead of oil for the lamps, the young lady brings water for the hanging baskets. This city is the nursery center of the State (Plate XIV).

Dufaycolors by J. Baylor Roberts

TERRA COTTA COWS DRINK FROM AN AMES FOUNTAIN

One of the restful nooks on the Iowa State College campus is the cool court of the Dairy Industries Building.

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Dufaycolor by J. Baylor Roberts

SYMBOLIC OF THE SETTLING OF IOWA IS THE 52-FOOT MURAL "WESTWARD" OVER THE MAIN STAIRWAY IN THE CAPITOL

The artist, Edwin H. Blashfield of New York, caught the courageous and hopeful spirit of the pioneers and told the story of the winning of the West in this dramatic painting of dreams and an ox-drawn "prairie schooner."

© National Geographic Society

Kodachrome by J. Baylor Roberts

MILES OF PHLOX MAKE SUMMERTIME GLORIOUS NEAR SHENANDOAH

Though Iowa is known as "the State where the tall corn grows," its rich soil is productive of many other crops. The southwestern part is an area of nurseries and flower-seed gardens. Extensive vineyards flourish in the country around Council Bluffs.

© National Geographic Society

Kodachrome by Lawrence Liggett

PELLA DUTCH IN FULL COSTUME SHOW VISITORS HOW THEY TIDY UP "THE CLEANEST CITY IN IOWA"

In keeping with a custom of their Netherland ancestors is the street scrubbing at the annual tulip festival. More than 1,200,000 fancy bulbs imported from the Netherlands and planted around lawn edges and parking strips, bloom simultaneously at the beginning of the April celebration.

Dufaycolor by J. Baylor Roberts

EVERY INCH A QUEEN IS BEAUTY DE BERGHES

This mare, raised at Ogden, in the central part of the State, won a blue ribbon in the National Belgian Horse Show conducted at Waterloo, Iowa, in connection with the Dairy Cattle Congress.

© National Geographic Society

Kodachrome by J. Baylor Roberts

NOT CORN BUT A KIND OF SUGAR CANE, SORGO IS GROWN FOR SILAGE

Though of little value for making molasses, it has become a profitable forage crop popular among breeders of cattle, for the sweet juice makes it a quick fattener.

services as an interpreter aided United States Army officers in establishing the forts and trading posts so necessary to the winning of the West. The building was the first railway station in Davenport.

From the Palmer School of Chiropractic, founded before 1900 by D. D. Palmer, originator of the method of treatment, and developed by his son, have been graduated more than half the practitioners of this profession in the United States. Hundreds of visitors are attracted to the school grounds to see "A Little Bit of Heaven," a museum containing art and curios collected from all over the world by B. J. Palmer.

Not only is Davenport a prosperous and fast-growing industrial city; it is also outstanding for its cultural development. Matthais Rholfs, who brought a piano here from Germany in 1847 and gave the first concert before a crowd of amazed Indians, would revel today in the brilliant audiences that enthusiastically support several German singing groups, a philharmonic society, and other musical organizations of far more than local renown.

Between Davenport and Clinton we passed through Le Claire, boyhood home of Col. William F. Cody, "Buffalo Bill." The famous Indian fighter and showman was born on a farm near the town. A short distance from the highway stands a huge elm tree once known as the "Green Tree Hotel," and now marked with a monument to Buffalo Bill.

Antoine Le Claire, soon after the War of 1812, held conferences with the Indians under the shelter of this tree, and river roustabouts who had squandered their wages in the frontier saloons were wont to camp there while waiting for a steamboat on which they might obtain new jobs.

WHERE CORN BECOMES SYRUP

We found elm-shaded Clinton in a state of excitement over the prospect of a new Cellophane industry. Besides extensive railroad yards and shops, it has numerous factories, the largest of them a corn syrup and by-products plant which has equipment to grind 30,000 bushels of corn a day.

The city was recognized in the early eighties as one of the world's leading lumber producers, so much timber being sawed in its mills that sloughs and creeks were filled with sawdust and whole residential districts built over them; but that trade dwindled and died with the cessation of log rafting from the north.

Of historic interest is a huge natural stone face on a limestone cliff in Eagle Point Park. The Indians of early days believed the face an emissary sent by the Great Spirit to guard fish and game.

The highway to Dubuque passes over parts of the old Military Road that superseded the trail marked by Lyman Dillon's hundred-mile furrow (page 143).

DUBUQUE SET A RIVER AFIRE

First white man to establish a permanent home in Iowa land, a French Canadian, Julien Dubuque, began in 1788 to take lead ore from "the Mines of Spain" in the Mississippi River bluffs at Catfish Creek. He obtained the concession from the Spanish governor of Louisiana. Thus began the city of Dubuque (Plate VII).

The adventurous miner was a genius at getting along with the Indians. They called him their brother "Little Night," and at his death vied with one another for the privilege of carrying him to the grave.

Once when the Fox refused to grant a request of his, Dubuque threatened to burn the whole Mississippi River, but the chiefs merely scoffed at him. He invited them to a powwow around a council fire on the bank of Catfish Creek. At a signal one of his helpers secretly poured a barrel of oil on the water above the meeting place, and Dubuque suddenly paused in his oration, seized a brand from the fire, and tossed it into the creek. The resulting conflagration so frightened the Indians that they yielded the argument at once, beseeching him to quench the flames. Most graciously he consented—as the last oil was consumed.

An amusing story is told of the first schoolteacher in Dubuque. He was captured by the Indians in the Black Hawk War, and later sold to a trader for a plug of tobacco because he was too bald-headed to be scalped.

After the lead deposits had been worked out, Dubuque, like its river neighbors, became a sawmill city and, when that business ended, turned its attention to woodworking. Some of the largest sash and door mills in the world are located here. Of particular interest to me was the big maizewood plant where cornstalk lumber of several kinds is manufactured commercially after Dr. Sweeney's formulae (page 150).

Photograph by J. Baylor Roberts

BUTTON, BUTTON, MUSCATINE HAS THE BUTTONS

Round "blanks," cut from mussel shells taken from the Mississippi River, are run through this grinding machine to remove the barklike outside surface and to bring them to the proper thickness. Next, thread holes will be drilled and the edges trimmed. The disks are then submerged in acid, washed, dried in sawdust, and sorted (page 166).

In northeastern Iowa the scenery is more rugged than in most other parts of the State. Limestone cliffs crowned with forest growth border rivers and creeks, and many of the farms are hilly.

White Pine Hollow Preserve, between Dubuque and Guttenberg, contains all that is left of the once magnificent forest which helped feed sawmills of the river cities.

In early times migrating passenger pigeons flew over this woodland in such numbers that they darkened the sky for days. Slaughter of thousands of them by the settlers seemed not to diminish the flocks, but in 1871 the main body went north and never returned. A few of this now extinct species were seen in Iowa as late as 1876.

We saw from the river road north of McGregor and Marquette thousands of migrating wild ducks and geese resting on the rippling surface of the Mississippi. Instinctively they seemed to sense that no one would harm them, for some were paddling about unconcernedly among small craft anchored on the Wisconsin side.

The country southwest of Decorah abounds in historic interest. At the Bohemian (Czech) town of Spillville, Antonin Dvořák lived during the summer of 1893 while he was composing some of his major musical works, probably portions of his *New World Symphony*.

Whisky Grove near Calmar was so named because it was the lurking place of an Indian who, paradoxically, sold liquor to Fort Atkinson soldiers in territorial days.

Built in 1840 to protect, not white settlers from the Indians, but the Winnebago Indians from the Sac and Fox and the Sioux, Fort Atkinson was a United States Army post of unique purpose. Part of it has been restored, and the tract on which it stands is a State park.

BIRTHPLACE OF THE WORD "TRACTOR"

In Charles City around the turn of the century Charles W. Hart and Charles H. Parr began to build stationary gas engines and to experiment with traction motors for use in agriculture. Their advertising manager coined the word "tractor" to describe the machine destined to revolu-

Photograph by J. Baylor Roberts

IOWA LEADS THE NATION IN NUMBER OF CHICKENS ON FARMS

In the old days of horse and mule agriculture, they scratched for a living around stables and barnyards, but now fowls of better quality are raised for the market. This girl on a poultry ranch near Yale is feeding a lusty flock in which barred Plymouth Rocks predominate.

tionize farming. Today the Hart-Parr Company has agents in 37 foreign countries and in its busiest seasons makes daily shipments of trainloads of tractors.

Iowa did not give its women the right to vote until the 19th Amendment was added to the Constitution of the United States; yet the State was the home of two of the best-known leaders in the struggle for women's rights. As a girl, Carrie Lane Chapman Catt lived on a farm near Charles City and at the peak of her career made her home in the town. Amelia Jenks Bloomer, 1818-1894, pioneer campaigner for woman suffrage and dress reform—"bloomers" were named for her—is buried at Council Bluffs.

Largest town in northern Iowa, Mason City is the trading center for a broad district of fertile farms. Two Portland cement factories here produce five per cent of the total output in the United States, and the brick and tile plants make in a prosperous year more than 200,000 tons of clayware.

Though burning kilns and factory chimneys can be seen on all sides, they do not spoil the peaceful farm scene. The good earth continues to produce its quota of food crops in the shadow of industry.

On our way down to Waterloo we paused near Nashua to see the "Little Brown Church in the Vale," built three quarters of a century ago, and subject of the familiar hymn. The village of Bradford where it stands is now almost deserted, but services continue, and couples come from near and far to be married there.

Home of the Dairy Cattle Congress and Allied Exposition and the National Belgian Horse Show, Waterloo is host for a week each year to stockbreeders from all parts of the United States (Plate XVI).

Here are the Rath Packing Plant, which handles more than a million and a half animals annually; the John Deere Tractor Plant, making 13 types of tractors as well as stationary and portable engines from two to 42 horsepower; and the Galloway Plant, manufacturers of farm machinery marketed through mail orders. Waterloo, population less than 50,000, produces one-fifth of the United States total of farm-type gasoline engines!

At Cedar Falls we visited Iowa State

Photograph by J. Baylor Roberts

TWO IOWA FARM BOYS HARNESSED THE WIND FOR ELECTRICITY

Because no other power was available, they hitched a windmill propeller to an automobile generator to operate the family radio. A factory in Sioux City now manufactures equipment by which electricity is generated by the breezes and stored in wet-cell batteries for rural use. Installations have been made in 119 countries.

Teachers' College, the only normal school maintained by the State. Its graduates have done yeoman service in the grade and secondary schools.

There is a restaurant in Marshalltown "under the viaduct 'down by the winegar woiks'" that I unhesitatingly recommend to the traveler who wishes to savor old-fashioned Iowa cooking. On the menu are such homely items as pig's feet, spareribs, and stuffed beef heart, prepared in true country style. One might wax poetic over the chiffon pie.

If I were asked to select a characteristic Iowa town, tree-bowered Marshalltown would be among the first to come to mind. Its 18,000 people are 91 per cent native white, even the workers in the fifty-odd factories being recruited from the farms near by. Everybody seems to know everybody else, and there is an atmosphere of hearty friendliness that makes the stranger feel at home. Here is the Iowa Soldiers' Home, established more than a half century ago for Civil War veterans.

A short drive east of Marshalltown is Tama, where about 400 Sac and Fox Indians, pathetic remnant of the tribes that once possessed all of Iowa, own a 3,300-acre "reservation," renting enough of their land to white farmers to pay their taxes.

Gentle, soft-voiced Horace Poweshiek, descendant of chieftains, told me how their forefathers, banished to Kansas by Government order in 1842, became homesick and wandered back to Iowa to purchase this loved land with funds saved from their allotments. Though "their arrows are broken . . . and their council fires have long since died out," they cling proudly to the traditions of their race.

OTTUMWA, "RIPPLING WATERS"

I could envisage as we went south from Tama to Ottumwa—"rippling waters" of Indian legend—the rush of white settlers who dispossessed the red men of their favorite hunting grounds. At midnight of April 30, 1843, representatives of the United States Government gave a signal

that started a race for land and brought into Wapello County in a few days about 2,000 men, women, and children. Ottumwa, now a city of almost 29,000 population, sprang up like magic. Little wonder that Edna Ferber, who lived here in her childhood, had the background to write vividly of a land rush in her Oklahoma novel *Cimarron,* or that the native daughter, Honoré Willsie Morrow, should know the characters of western pioneers.

The packing plant of John Morrell and Company is the leading industry in Ottumwa. Attracted by the name of the town, an English provisioner established a half century ago the organization which is today the largest independent pork processing business in the world.

Mining of vast deposits of bituminous coal, which underlie about 19,000 square miles of the Des Moines River Valley, has made possible the development of manufacturing in Ottumwa as in other southern and central Iowa cities; yet agriculture remains the basis of prosperity. While the miners work in the deep shafts, farmers grow bountiful crops above them.

Knoxville, through which we passed on our way back to Des Moines, was the scene of a land race similar to that in Wapello County, but two years later. Moving ever westward, strip by strip, the pioneers ousted the Indians from Iowa.

Near the coal-mining and railroad city of Boone, north of Des Moines, is Ledges State Park, one of 72 recreation areas acquired by the State since 1919 and developed rapidly in the last decade under the Twenty-five-Year Plan, which furthers conservation of natural resources.

In a Fort Dodge hotel we enjoyed a real Iowa chicken and dumpling Sunday dinner. What memories it brought back of hot afternoons long ago when, torpid from just such food, I lounged drowsily on the front porch and hoped I should not have to go to church in the evening.

One of the largest deposits of gypsum in the United States, a bed of 30 square miles, enables Fort Dodge to turn out about 170,000 tons of plaster and allied products annually.

A WRESTLER WINS A COUNTY SEAT

How Fort Dodge became the seat of Webster County is a story old-timers tell with relish. "An engine in pants" by the name of John F. Duncombe decided soon after his arrival in the town in 1855 that he would take the county seat away from the larger town of Homer. In the election the following year Fort Dodge was announced the winner.

John Maxwell, who had conducted the contest for Homer, charged that Duncombe had cheated. At the suggestion of citizens of both towns, the two leaders fought out the issue in a wrestling match in the Homer town square. Duncombe, though the smaller of the two, won the fall, and the county records were moved to Fort Dodge. Today Homer is a tiny village and Fort Dodge a city of nearly 25,000.

TRACTOR VERSUS HORSE AND MULE

The countryside became increasingly familiar to me as we drove westward from Fort Dodge into the scenes of my boyhood; yet I felt that something was changed. Suddenly I realized what I had been missing. Men were working in the fields with tractors instead of horses and mules.

Since my departure from Iowa, agriculture has been mechanized to an amazing extent. The modern machines, particularly tractors and corn pickers, have lightened the farmers' toil and at the same time driven many laborers to seek employment in the cities. In interviews with farmers, I soon discovered that opinion is divided.

One man was emphatically against the modern idea. "I stick to my horses and mules," he said. "They work on the oats I grow on the place instead of gasoline; the manure from their stables keeps my land rich and protects it from sheet erosion; they cost less than the machines, and last longer; and I don't have to be a mechanic to operate them. Of course my boys and I all have to work from sunup to sundown and we hire five or six extra men; but I'm glad, because the work holds the boys with me on the farm."

The man across the road declared in favor of complete mechanization: "Before we had tractors and corn pickers, Mary and I never got a vacation. Now we have time to go places. Of course we have to buy fertilizer to put on our land, but we save the cost of it by not having to hire a lot of extra help for Mary to cook for."

Iowa has been for many years the Nation's leading producer of popcorn, and Sac and Ida counties yield more than any other part of the State. In the old days our village editor delighted in telling how

Photograph by J. Baylor Roberts

ELKADER CHILDREN GO TO SCHOOL IN A GLASS HOUSE

Built of hollow glass blocks eight inches square and four inches thick, this edifice admits a maximum of natural light without glare, shuts out noise, and insulates against heat and cold. Desks and chairs are of hard rubber, and floors of asphalt tiling and metal lath. From the third grade through high school 500 pupils are accommodated. The ultramodern structure is a far cry from the several thousand little white rural schoolhouses which for decades have done yeoman service in making Iowa the most literate State in the Union (page 143).

big a heap of white kernels could be popped from the thousands of wagonloads shipped each fall from Odebolt, "the popcorn center of the world."

WEATHER MEANS EVERYTHING IN IOWA

In August of 1936, when one of the worst droughts on record was cutting the value of Iowa crops almost in half, and the western part of the State was particularly unfortunate, I visited in Ida Grove. A little lad at a filling station, seeing the District of Columbia license on my car, asked politely, "How is the weather out in Columbia?" To him as to his elders, that was the most important topic of conversation.

The weather at the time of my latest visit was much kinder to growing things, but as unpredictable as I remembered it from my youth. I had sweltered under a broiling sun at the Drake Relays on April 29, and two weeks later I rode from Ida Grove to Des Moines through a snowstorm!

In the northwestern counties are the largest lakes in Iowa. I was saddened to find Black Hawk Lake at Lake View, vacation spot of fond memory, so silted up that State-operated dredges were at work digging a channel in the center of it to save a small portion for recreation purposes. Storm Lake, however, had apparently escaped serious silting, and the Iowa Great Lakes, Spirit and the two Okobojis, near the Minnesota border, were more attractive than my recollections of them (Plate X).

From the lake region we swung southwest through the Dutch town of Orange City (Color Plate IX), to Le Mars where in early days a colony of wealthy young Englishmen, living in the style of British country gentlemen, raised fancy cattle for a livelihood and sought amusement by riding to hounds or playing polo and cricket. The colony, like the French Icarian community established near Corning in 1858 and abandoned forty years later, was not a permanent success. Nowadays, only old settlers in Le Mars remember the "Johnny Bulls who used to dress up in boiled shirts to eat at night what they called 'dinner.'"

Photograph by J. Baylor Roberts

A BROOKLYN, IOWA, GIRL LEADS HER PET AYRSHIRE HEIFER TO THE SHOW RING

On the elaborately equipped State Fair Grounds at Des Moines a tent city housing thousands of exhibitors and their families springs up the last week of every August. For six eventful days rural Iowa goes on parade with harness races, displays of the blue bloods of the stock world, exhibits of the finest products of the soil, and activities of 4-H Club boys and girls (Plate IX).

Sioux City, second metropolis of Iowa with its more than 80,000 people, is a river town, but differs as much from the cities on the eastern border as the turbid Missouri, which flows past it, differs from the traffic-bearing Mississippi. By the expenditure of enormous sums, the Federal Government is seeking to make the Missouri navigable again, but some Iowans say they have seen the "Big Muddy" change its course too often to believe mere man can tame it.

"When the river goes on a rampage," one man told me, "it often moves over a mile or two and makes a new bed where there were fine farms. A man who owns a place on its bank never knows when his land will be under the middle of the current or reduced to sand banks on the Nebraska side."

SIOUX CITY PACKING STARTED BY ACCIDENT

Through a whim of the Missouri River were started the packing industries and stockyards which have made Sioux City one of the leading livestock markets in the United States. A boatload of wheat sank or was grounded on a sand bar opposite the town in the middle eighties, and James E. Booge bought and salvaged the cargo. Because the water-soaked grain was worthless for any purpose but feeding, he began to purchase and fatten hogs. There was little market for live animals; therefore the pioneer built a small packing plant.

Today the Sioux City stockyards accommodate at capacity 45,000 hogs, 25,000 cattle, 25,000 sheep, and 1,000 horses and mules (page 163); and plants of several of the largest packing companies in the country are operated near by.

Leaving the Missouri River for a time, we zigzagged down into the famous nursery district in the southwestern part of the State (Color Plates XII and XIV). Past fields brilliant with phlox and through miles of vineyard country, we drove to historic Council Bluffs, important railway and mail transfer point on the Missouri. Lewis and Clark camped on the site in 1804, and 23 years later an agent of the American Fur Company set up there a permanent trading post known as Hart's Bluff.

When the Mormons were making their

Photograph by J. Baylor Roberts

AT COUNCIL BLUFFS A MIGHTY BRIDGE BIDS WELCOME TO BUFFALO LAND

Vast herds of the animals roamed the plains in 1863 when Abraham Lincoln chose the city as the eastern terminus of the continent-crossing Union Pacific. Today 63 passenger trains of eight systems serve the division point. Fittingly, the span connecting Iowa with Omaha, Nebraska, is adorned with a 7-foot bronze bison head.

long trek to Utah in 1846, a large band of them came to Hart's Bluff and, finding the country to their liking, decided to remain for a time. They built homes, obtained from Albia permission to organize a township government, and took part in the congressional election of 1848. Soon they changed the name of the community to Miller's Hollow and later to Kanesville.

Kanesville was a boisterous frontier town during the California gold rush, desperadoes, gamblers, and other unsavory characters flocking there to prey on the forty-niners. Aroused citizens organized vigilance committees, and lynchings were frequent.

In 1852 Brigham Young called all his followers to Utah, and nearly 8,000 left Kanesville. The thousand non-Mormon settlers changed the name to Council Bluffs.

There is little nowadays in this busy city of more than 43,000 to recall its dramatic past. Surrounded by thousands of acres of vineyards, some of which reach into the corporate limits, it is, outside its business section, a peaceful farm community.

"A peaceful farm community"—those words may be applied to all of Iowa. As we rolled over the bridge from Council Bluffs to Omaha, Nebraska, bits of the State song came back to my mind:

> See yonder fields of tasseled corn,
> Iowa, in Iowa,
> Where Plenty fills her golden horn,
> Iowa, in Iowa.

Truly it is "a good land and a large, a land flowing with milk and honey."

DISCOVERING THE NEW WORLD'S OLDEST DATED WORK OF MAN

A Maya Monument Inscribed 291 B. C. is Unearthed Near a Huge Stone Head by a Geographic-Smithsonian Expedition in Mexico

By Matthew W. Stirling

Leader of the National Geographic Society–Smithsonian Institution Expedition to Vera Cruz

With Illustrations from Photographs by Richard H. Stewart

DOWN in the jungle of southeastern Mexico an expedition jointly sponsored by the National Geographic Society and the Smithsonian Institution has just brought to light a Maya monument bearing the earliest date yet discovered in the Western Hemisphere.

The date, corresponding to November 4, 291 B. C.,* is carved in delicate Maya symbols which were preserved from destruction by time and weather through a remarkable combination of circumstances.

Almost as significant as the date itself is the fact that this and other evidences of the culture usually considered characteristic of the Maya Indians have been unearthed well outside the supposed limits of the vanished Maya civilization.

Since the carving appears on a slab of stone too heavy to be transported far, it proves that the Maya inhabited this region in the present Mexican State of Vera Cruz. It thus extends westward by about 150 miles the previously known limit of Mayan settlements and cities (map, page 184).

A COLOSSAL HEAD GIVES CLUE

How we found the telltale monument is a long and absorbing story. It rightly begins in 1858 when a native workman, clearing a virgin patch of jungle growth in the State of Vera Cruz, encountered, embedded in the heavy black soil, what he thought to be the bottom of an enormous inverted kettle.

Excitedly he reported his discovery to the proprietor of the near-by hacienda of Hueyapa. With visions of buried treasure, the proprietor brought a crew of men to excavate the "kettle."

As the digging progressed, the object was revealed to be the upper part of an enormous head skillfully carved from a great block of basalt, which had become blackened from exposure. Disappointed in the treasure search, the investigators proceeded no farther.

Nature and the process of erosion soon reburied the giant piece of sculpture, but the tradition of the Colossal Head of Hueyapa lingered on in the region and on at least two occasions subsequently attracted the attention of scientifically minded travelers in the vicinity. In spite of its spectacular nature, it never came to general public notice and was virtually forgotten.

TUXTLA STATUETTE, 2,000 YEARS OLD, PORTRAYS A FAT, JOLLY PRIEST

Forty years later, around the beginning of the present century, another native near the old town of San Andrés Tuxtla, about 15 miles from Hueyapa, was working in a tobacco field when his eye chanced to spot a piece of shining pale-green stone.

Clearing the object with his fingers, he picked up a small jadeite figurine. About eight inches in height, it represented a fat and apparently bald-headed Indian priest with wide-open eyes that seemed full of good humor. Over the lower portion of the face was a mask in the form of a duck's bill, and draped over the shoulders was a feather robe representing the folded wings of a bird. Decorating the front of the figure were some curious-looking incised characters and arranged in a column down the middle was a row of simple bars and dots (page 188).

The obscure native was likely never to know it, but he was holding in his hand what was destined to become probably the most famous archeological object found in the New World. Eventually the little duck-

* This is according to the H. J. Spinden correlation. If the J. E. Thompson correlation, which carries the calendar forward 260 years, is used, the reading becomes 31 B. C.

Drawn by Newman Bumstead

IN THE STATE OF VERA CRUZ, MEXICO, A GEOGRAPHIC-SMITHSONIAN EXPEDITION DISCOVERS A NEW CENTER OF MAYA CULTURE

The circle marks the farthest-west area in which have been found evidences of these "Greeks of the New World." For four months in the winter and spring of 1939 the expedition conducted excavations here in the Canton of the Tuxtlas. Comalcalco, in the State of Tabasco, is the nearest known Mayan site.

billed figure found its way to the United States National Museum, where it was discovered that the column of bars and dots recorded a date in the Maya calendar corresponding to a day almost a hundred years before the time of Christ. Known as the "Tuxtla Statuette," it now constitutes one of the most interesting objects in the National Museum.

As time went on, it became the subject of much discussion. The form of the glyphs and the style of carving were archaic and quite different from the characters carved on the dated monuments in the Maya area to the east. In addition to this, the nearest known Maya site was Comalcalco, about 150 miles away. Chichen Itzá, center of the extensive excavations carried on since 1924 by the Carnegie Institution of Washington, was 475 miles distant.*

Being small, the Tuxtla Statuette could easily have been carried any distance. Thus many questions came to mind. Was the date carved at the same time the figure was made or had it been put on at a later time by a different people? Did the date represent a contemporaneous period or did it refer to some earlier event, as we might erect a monument to George Washington in 1939 and put on it the date of 1776?

If the date was contemporary, was it placed there by the early Maya or did some other group living in this region invent the calendar and later pass it on to the Maya?

Northwest of this area, around the Pánuco River, live the Huastec Indians, who

* See "Unearthing America's Ancient History" and "Yucatán, Home of the Gifted Maya," both by Sylvanus Griswold Morley, in the NATIONAL GEOGRAPHIC MAGAZINE for July, 1931, and November, 1936, respectively.

FIRST PRIZE FOR THE EXPEDITION'S SHOVELS WAS THIS PREHISTORIC "DOUGHBOY"

The Colossal Head, being measured by Matthew W. Stirling, leader of the National Geographic Society-Smithsonian Institution Expedition, is about 6 feet high and 18 feet in circumference. Carved from a single massive block of basalt, it is remarkable for its lifelike appearance entirely different from any other known American Indian sculpture (pages 183, 187, and 207). Its partly exposed "helmet" led the expedition to the Tres Zapotes area.

speak a language closely related to Maya but whose culture otherwise is quite different. Did the ancestors of both the Maya and the Huastec formerly live in southern Vera Cruz?

GIANT HEAD BURIED TO ITS BROW

In the hope of discovering some new information that might assist in answering these questions, I took the opportunity, when in Vera Cruz early in 1938, to visit the Colossal Head. After an eight-hour horseback ride from Tlacotalpan to Hueyapa, I learned that the head was located not at Hueyapa but within a mile of the village of Tres Zapotes.

Buried to its forehead, I found the object of my quest standing in a plaza formed by four mounds. I cleared away the earth from the face and took photographs.

Investigating the neighborhood further, I found that somewhat to the east of this plaza was another group of very large mounds, one of which was almost 450 feet in length. Beyond these, on an elevated piece of land, was a third group, the central feature of which was another plaza surrounded by four large mounds.

WHEN ROME WAS IN ITS HEYDAY, SOME TWO THOUSAND YEARS AGO, A CITY OF THATCHED HOMES AND TEMPLES FLOURISHED HERE

Workmen, in the center, are excavating a low mound which was originally a platform for a temple or ceremonial house. The larger hills mark the city's civic center. Jungle growth has long hidden the earth platforms, religious statues, and monuments. Between the temples extended spacious plazas where the people congregated for ceremonies. Because of the lack of stone in the vicinity, no masonry structures are found at Tres Zapotes.

THE COLOSSAL HEAD DREW CROWDS OF NATIVE SIGHTSEERS EVERY SUNDAY

The rounded top of the figure and part of the circular groove had protruded from the soil for many years, but no one had taken the trouble to investigate the real character of the monument. When the earth was removed it was found that the head terminates at the neck, resting on a foundation of unworked stones. The sculpture was located in a depression impossible to drain. Although the expedition operated in the dry season, unscheduled rains often occurred. The pit was bailed three times in a week and to empty it each time was a two-day job (pages 183, 185).

Photograph by Willard R. Culver

THIS CHEERFUL DUCK-BILLED GODLET BORE THE OLDEST AMERICAN DATE BEFORE THE NATIONAL GEOGRAPHIC EXPEDITION

The Tuxtla Statuette, plowed up in a field near San Andrés Tuxtla, Vera Cruz State, in 1902, only 15 miles from the dated stela (page 183), is a prized possession of the National Museum in Washington. Maya bar and dot characters on the figure's stomach indicate the date 98 B. C.

Upon my return to Washington, some of the staff members of the National Geographic Society saw the photographs of the Colossal Head and realized the potential importance of the site. Accordingly, an expedition was organized as a co-operative endeavor of the National Geographic Society and the Smithsonian Institution. Permission for the work was readily granted by the Department of Prehispanic Monuments of the Mexican Government's Department of Public Education, which generously gave us every assistance.

Thus we finally found ourselves at the little port of Alvarado on our way to the Canton of the Tuxtlas, where we were to conduct our investigations (map, page 184).

UPSTREAM IN ALVARADO'S WAKE

As we left Alvarado in our venerable river launch to ascend the Papaloapan River, we could not help but think of that day, some 420 years before, when the dashing Pedro de Alvarado sailed through the narrow entrance to the bay which now bears his name, to make exactly the same trip we were about to undertake.

Bernal Díaz del Castillo, chronicler of the Grijalva expedition, forerunner of the famous voyage of conquest of Cortez, left this brief statement concerning the discovery of the Papaloapan River:

"As we followed along the coast, the Captain, Pedro de Alvarado, went ahead with his ship and entered a river which the Indians call Papaloapan, and which we then called the Rio de Alvarado, because Alvarado was the first to enter it. There some Indian fishermen, natives of a town called Tlacotalpa, gave him some fish.

"We waited at the mouth of the river with the other three ships until Alvarado came out, and the General was very angry with

Photograph by Alexander Wetmore

RAILS END AT ALVARADO

This little town lying on a sand spit near the city of Veracruz bears the name of Pedro de Alvarado, who first explored the region in 1518. The expedition journeyed from here by waterways and trails to Tres Zapotes.

"CURB SERVICE" IN TRES ZAPOTES

Customers on horseback may ride onto the dirt-floored porch to make their purchases. In this "department" store the natives buy almost any commodity from clothing, harness, and canned soup to liquors and cigars. It serves as the village social center because of its radio.

THEIR PICKS AND SHOVELS ARE BRINGING TO LIGHT NEW CHAPTERS IN AMERICA'S PRE-HISTORY

This is one of the three shifts of local workers who dug among the Tres Zapotes mounds. Each crew of 30 men worked three days consecutively. Standing to the right of The Society's flag are Mrs. Matthew W. Stirling, Mr. Stirling, Mrs. C. W. Weiant, Dr. Alexander Wetmore, and Dr. Weiant. The laborers have assembled for roll call. Men carrying rifles are part of the local police force.

AN ANCIENT OWL PEERS WIDE-EYED AT THE 20TH CENTURY

Carved by some skillful craftsman centuries ago, it probably adorned a temple. The owl was a favorite subject for artists of the Maya and neighboring tribes.

NATURE FURNISHES THE UMBRELLAS IN TRES ZAPOTES

Natives often protect themselves from the rain by holding overhead gigantic leaves of the elephant's ear, which grows abundantly in the swampy jungles.

VAQUERO SINCE BABYHOOD

This handsome young rider is the son of one of the leading citizens of Tres Zapotes, where the excavations were conducted. Small boys whose parents own horses ride as soon as they can walk.

him for going up the river without his permission, and ordered him never to go ahead of the other ships again, lest an accident should happen when we could not give him help."

At the time of the conquest, this remote section of Mexico had already come under the domination of the great Aztec ruler, Montezuma, and fresh fish were carried in relays over the rugged mountain barriers to the Valley of Mexico by a chain of swift runners, in order that the table of the Emperor might be supplied with seafood.

Today an ice plant operates in Tlacotalpan and now, almost half a millennium later, fresh fish from the "River of Butterflies" are still carried, by more modern methods of transportation, across the same mountains to the Valley of Mexico, where, as in the days of Montezuma, the city dwellers and the travelers may enjoy this luxury; for fishing is still the leading industry of the picturesque town of Tlacotalpan.

HAZY PEAKS MARK GOAL

The red-tiled roofs of Alvarado receded behind us as our launch crossed the shallow bay and entered the river. As we chugged between mangrove-covered banks, close on our left hand rose the great sand hills which lie behind the seacoast. Across the vast level plain to the west loomed the pale-blue range of the sierras and, towering over all, hung ghostlike the snow-covered cone of Orizaba (Citlaltepetl), principal landmark for Cortez.

Our hearts beat a little faster when first we distinguished to the eastward the hazy volcanic peaks of the Tuxtla mountains, at the base of which lay our goal.

What were we destined to encounter there? One thing was certain—the Colossal Head! Would we find it reposing in lonely grandeur, or would we discover the remains of a great city, worthy of such an ambitious work of art?

What would be revealed by the complete excavation of the head? Was it attached to a body? If so, what would be its position—crouching, seated, or standing?

Before we had much time to discuss such

questions, the white walls and red-tiled roofs of Tlacotalpan appeared ahead and we were soon busy transferring our baggage to the pretty little Hotel Cuauhtemoc.

Our launch next morning left the main river and entered a maze of winding channels often choked with masses of water hyacinths. They looked like millions of orchids in pale purple bloom.

NEWS BY "UNDERGROUND TELEGRAPH"

As we progressed, the mountains loomed closer, the banks of the streams became higher, and the scenery more picturesque. At times our launch passed through channels so narrow that we could touch either bank with our hands.

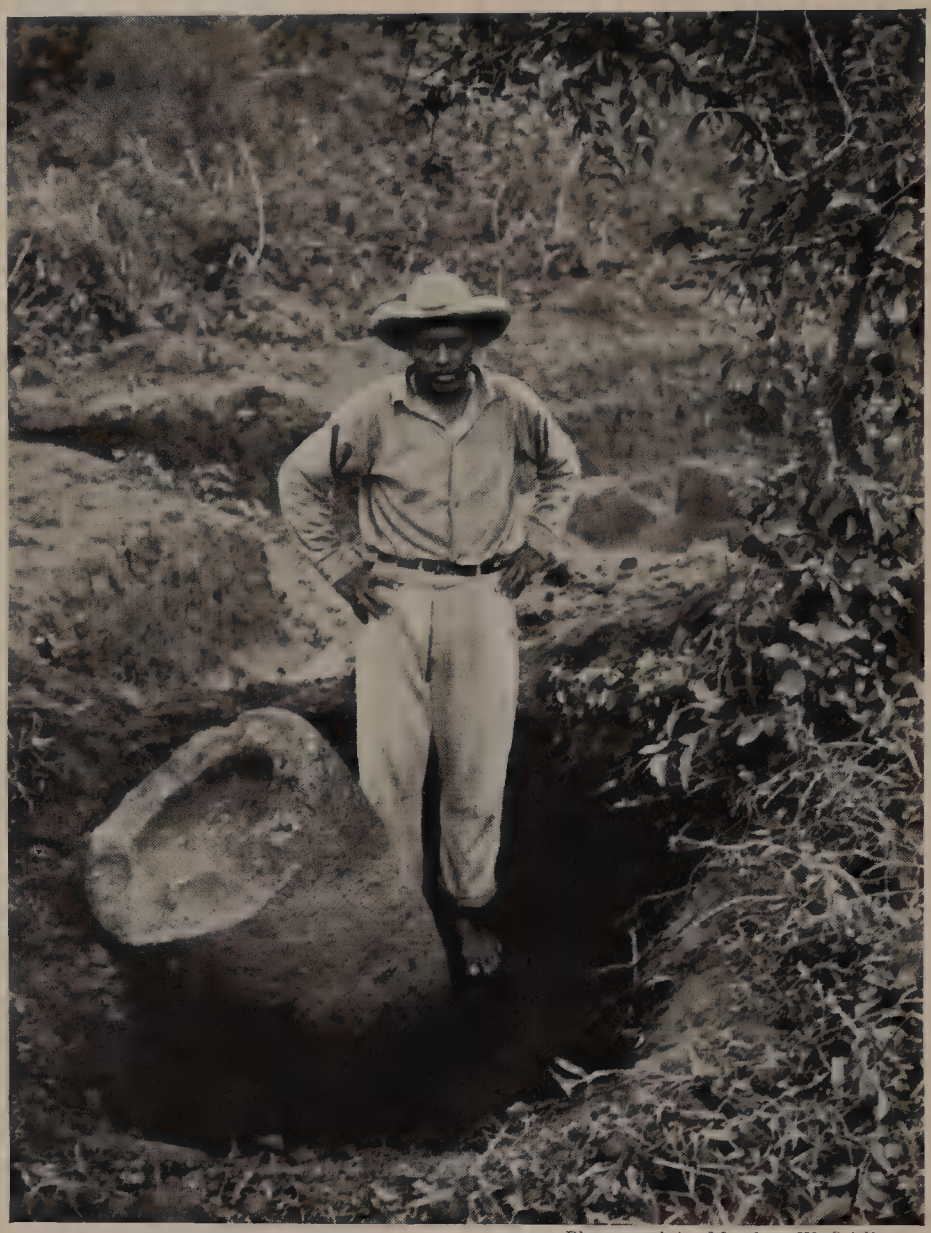
HE WILL PART WITH HIS PET FOR A PRICE

When it became known that Dr. Alexander Wetmore was making a collection of bird skins for scientific purposes, children began bringing in specimens which they had killed, even their pets. Since Dr. Wetmore wished to discourage indiscriminate destruction of birds, he purchased none from the natives.

At infrequent intervals we passed a solitary ranch house with its accompanying cattle corrals, and now and then mounted vaqueros rode to the bank of the stream to watch us pass and to exchange news with the crew of the launch. We were later to learn that this sort of thing was part of a highly efficient and purely voluntary "underground telegraph" which spread news with amazing rapidity.

When other members of our party came from Tlacotalpan by launch, we always learned of it in a most casual way from our workmen, who also reported whether the visitor was sick or well, what he was bringing with him of interest, and the approximate time he should arrive. In a manner that always seemed to us little short of miraculous, we invariably received such details a few hours before the newcomer appeared, usually to the great astonishment of the visitor, who found all preparations made for his arrival.

Occasionally our progress would be stopped as our propeller became fouled with the water hyacinths. At such times an amiable and well-nigh amphibious member of our crew of three would jump overboard



Photograph by Matthew W. Stirling

A TELLTALE DEPRESSION MARKS THE STONE FOR HUMAN SACRIFICE

The block was dug up near the carved stone box, visible in the background. On this stone the hearts of the human victims were torn out. Blood collected in the shallow basin was transferred to the storage box as an offering to the gods (opposite and page 196).

and, remaining under water a surprising length of time, would clear away the offending vegetation.

As we approached the higher land toward the foot of the mountains, the vegetation became more dense and more tropical in appearance. Groups of parrots flew noisily over head and now and then we spotted a big iguana, looking like some prehistoric monster, sunning itself on the vine-covered jungle wall bordering the stream.

Birds were so numerous and so varied that we felt confident Dr. Alexander Wetmore would find this an unusually rich field for collecting when he joined us later in the season (193).

Just before dark we entered the San Augustín River and shortly after found ourselves at Boca San Miguel. "La Boca," as it is called locally, consists of three small palm-thatched houses built in a clearing. Here under the direction of Ricardo Gutiérrez, the storekeeper of Tres Zapotes, mules were rounded up for us while we occupied ourselves in eating a meal of rice, beans, and cold tamales.

By the time our packs were on the mules and we ourselves were mounted, the sun had set and the quick darkness of the Tropics had descended on us. In spite of this, Ricardo started out with us up the trail, which we could not see at all; so we merely hunched down as low as possible in our saddles and put our complete faith in the mules. After riding for an hour and a half, we reached Tres Zapotes and then our camp.

ONCE HOME OF A NUMEROUS PEOPLE

Along the high ground at the base of the Tuxtla mountains and on the level plains below, there lived and prospered centuries ago a numerous and industrious people. The bulwark of the mountains

Photograph by Matthew W. Stirling

THE FINEST ART OBJECT FOUND BY THE EXPEDITION

The receptacle was probably used for holding the sacrificial blood (opposite and page 196). It is one of the most intricate and beautiful examples of stone carving ever uncovered in Mexico.

IN THESE CARVINGS GODS OR HEROES ENGAGE IN COSMIC COMBAT

Here is shown the remaining portion of one side of the decorated stone box. Each of the four sides had been completely covered with elaborate markings. The designs are highly symbolic; their exact significance is unknown.

A THICK-WALLED STONE BOX EMERGES FROM THE EARTH

Because of the beauty of its carvings, extreme care was taken in the excavation. The container was evidently broken in ancient times, as no fragments were found in its vicinity (pages 194 and 195).

Photograph by Matthew W. Stirling

THE BATH HOUR FOR CLAY BABIES

Mrs. Stirling and Mrs. Weiant are washing specimens in an all-purpose basin brought from Mexico City. In the foreground are empty gasoline tins, water "jugs" on frontiers the world round.

sheltered them from Gulf-born hurricanes; the fertile alluvial soil, lying in the tropical rain belt, supplied them with abundant food. The dry season here extends from December to June, during which time they planted and harvested their crops.

Detached from regular lanes of travel, this hinterland today constitutes a sort of backwash which makes it one of the most isolated sections of Mexico. On the lower San Juan and along the Papaloapan near Tlacotalpan, sugar cane is grown in the deep, rich soil, but the Canton of the Tuxtlas has long been famous for its excellent tobacco.

STELA D MAY RECORD A WEDDING OF LONG AGO

Three figures are carved in low relief in the yawning mouth of a grotesque animal which probably represents the Earth Monster. The style of carving is quite suggestive of Mayan art. The meaning of this scene is not known, but it may represent a wedding ceremony, as the central figure appears to be a woman. The monument is shown where it was found (page 198).

The Conquistadores were not long in learning of the productivity of this region and in the middle of the 16th century, when the choice land grants were being distributed, this area was given to a nephew of Cortez. It was discovered that when the jungle was cleared the resulting grassland furnished excellent grazing for stock and, until the revolution in the time of President Carranza, the area between the San Juan River and the Arroyo Hueyapa constituted an immense cattle range.

Today, two small abandoned adobe houses with tiled roofs, strangely out of place among the palm-thatched huts of Hueyapa, are all that remain to bear witness to those romantic hacienda days. Now the former grazing lands are blanketed with trees.

The wide region which once supported immense herds of cattle is again the haunt of the deer and the jaguar. Near the villages of Hueyapa and Tres Zapotes are miles of guava trees. Along the arroyo enormous sapotes and mangoes furnish abundant fruit in the summer.

Thus a great cycle has been completed. The ancient inhabitants wrested the land from the virgin jungle, the Spaniard maintained it as a cattle range, and now the jungle has again taken possession.

TWENTY MAN POWER WAS NEEDED TO RAISE STELA D

It was found in a marshy jungle, in the midst of a small group of mounds, four miles from camp. The heavy stone presented a problem in mechanics as it lay in deep adobe mud (page 197).

But the reputation of the fertile lands around Tres Zapotes has spread in the State of Vera Cruz and now the ax of the *milpero,* or pioneer farmer, is again being heard in the forests. More and more new land is being converted into maize fields as the village of Tres Zapotes grows and prospers, for the milperos are working for themselves instead of for the hacienda, and their own industry is all that is necessary to keep them from want.

The village itself constitutes an interesting social study. The Mexican Government allots to each town an area called an *ejido,* or communal tract of land. Upon application to the local village head, each resident may obtain a number of acres for cultivation.

NATIVES USE ANCIENT MAYA METHODS

Along the Arroyo Hueyapa, the *milpa* (clearing) system of agriculture is practiced today as it was 2,000 years ago. In the little clearings around the mounds are found growing maize, beans, and squash, the same plants that were raised by the ancient inhabitants. Two crops are grown each year, the exact date for planting and harvesting being designated by calendar today just as it was centuries ago by the early Maya, who used their own system of dating for that purpose (page 207).

With the good earth furnishing ample nourishment, the present Tres Zapotean is a fine type of rural Mexican. Healthy, independent, industrious, and honest, he is by temperament cheerful and fun-loving. We found the natives to be, almost without exception, intelligent and skillful workers, easy to train in the careful techniques essential to proper archeological excavation.

We planned to use a crew of 30 men. As there were about 100 able-bodied men in the village and we wished to give all an equal chance to work, we decided to operate with three crews of 30 men, each crew working in rotation three consecutive days. The town council appointed a representative to name each list and keep it up to quota. The men quickly became interested.

A LOG, POTENTIAL PUPILS, BUT NO TEACHER

There was no school in the neighborhood of Tres Zapotes last winter, but special taxes were being collected and plans made to build one. The doll clutched by the smaller girl is a homemade rag affair. Playthings are few among the native children. Small boys are content with slingshots made of forked sticks, rubber bands, and pieces of leather.

Dr. C. W. Weiant had been assigned the task of setting up the camp which was to serve as our headquarters and laboratory. The main structures were built in accordance with local architectural procedure, each consisting of a rectangular framework of logs with a palm-thatch roof and walls made from the midribs of palm leaves.

CONCRETE FLOORS A LUXURY

Locally, the earth serves as a floor, but we added a note of luxury by constructing concrete floors, which considerably facilitated the problem of housecleaning.

Our main house consisted of two large rooms, one of which served as a "guest" room, the other as storeroom and laboratory. Back of this were the two family houses occupied by Dr. and Mrs. Weiant and by Mrs. Stirling and me. Each family house contained two cots with mosquito nets, a washstand, a table to serve as a desk, and a mothproof clothes closet. Our suitcases, laid broadside on boxes, furnished additional storage space.

We made arrangements in the village for the hire of two young women, María to serve as cook and Valvina as maid of all work. Our kitchen range consisted of a large square box filled with hard-packed adobe. On this were placed two iron hoops fitted with tripod supports. Under these, our girls made wood fires and cooked our meals in locally made earthenware vessels.

From the village we obtained beans and rice, fresh beef or pork when available, and chicken consisting principally of feathers and bone. Eggs were usually procurable, as were seasoning materials (page 210).

On the whole the girls appeared proud of us as their employers, although they did not always approve of some of our peculiar customs. The dining table, placed under the palm-thatched porch of the main house, was covered with oilcloth, which was more or less impervious to the weather and

A HUMAN FIGURE IN STONE LIES HALF DROWNED AFTER A TROPICAL STORM

This was Stela A, the largest uncovered at Tres Zapotes (page 209). The huge stone, 17 feet long, 7 feet wide, and 20 inches thick, fell in ancient times and broke into two pieces. The carving in relief (here inverted) represents a human deity standing in the open mouth of a manlike monster. Lobo, the expedition dog, is an interested spectator as the workmen bail out the excavation. Because this stone was too heavy to turn, it was necessary to run tunnels beneath it in order to examine the back. Traces of elaborate carving can still be detected in the flat areas on either side of the standing figure, but because the stela fell face upward they have been so badly weathered that their exact nature cannot be deciphered.

easily cleaned. María and Valvina felt that people in our position should use a tablecloth and tactfully suggested this on numerous occasions!

Casual passers-by, also noting this lack, occasionally returned with various hand-embroidered specimens which they offered for sale, and, upon being turned down, inquired: "Don't you use tablecloths in your land?"

ON INTIMATE TERMS WITH INSECTS

While the thatch on our houses was new, we were confronted by a number of problems of an entomological nature. Large armies of ants were continually deciding that when they found our house in their way it was simpler to go right on through than to deviate from their course. Fat worms dropped like manna from the green roof—usually down our necks when we sat at the desk, or on top of the mosquito nets where they collected in quantities and sometimes even succeeded in working their way between the sheets.

Now and then a big hairy tarantula would make a social call and one evening when Mrs. Stirling was washing her face she felt something rough—a big black scorpion had taken refuge in her washcloth!

After the wettest part of the rainy season had subsided and the palm leaves forming the roof had become dry, these visitations became much less frequent.

"LITTLE BROTHERS UNDER THE SKIN"

The principal pests of Tres Zapotes, however, were the ticks. These were of three sizes, called respectively *conchutas, garapatas,* and *pinolillos.* The conchutas are about a quarter of an inch in length and the pinolillos so small as to be barely noticeable to the eye.

These pinolillos, "little brothers under the skin," as Weiant called them, cluster in balls about a half inch in diameter, which gather ingeniously on the ends of twigs or grass stems projecting over a path. From this advantageous position they instantly detach themselves in a veritable cloud and pepper the clothing or bodies of any person or animal passing by.

Once such a swarm gets aboard one's trouser leg, if not noticed at once and beaten off, they speedily apportion one's body; each having laid claim to a certain section, they proceed to burrow in and bury themselves beneath the skin, where they gorge with blood and remain for days to grow. Each locality thus possessed on the skin soon sets up an itch out of all proportion to the size of the burrow.

The faculty of these pests for filtering through and under tight-laced boots and riding breeches is unbelievable. We tried various applications ranging from liquid aguardiente to powdered sulphur in the vain hope that they might have a discouraging effect. The pinolillos, however, seemed to feel that these garnishings merely gave added flavor to the skin and went about their labors with customary zest.

The only way, we discovered, to avoid their evil effects was to go over our bodies carefully from stem to stern each evening, close to the bright light of a gasoline lantern, to locate and pick them off patiently, one by one. If they were allowed to remain over night, it would be too late, as by morning they had had time to burrow under.

MEN PRIZE SHOES FOR DANCING

The social life of Tres Zapotes reached a climax each week end with dances which were held on Saturday and Sunday nights. The favorite dance typical of southern Vera Cruz is the *huapango,* the music for which is furnished by two instruments, a stringed one called a *jarana* and a homemade guitar. It is danced by two women or by a man and a woman.

The men are allowed considerably more freedom of movement in the dance than the women, who stand with the hands on the hips or holding the skirt while the lively rhythm of the dance is stamped with the heels; all the movement is from the waist down.

The ambition of every Tres Zapotes man is to save enough money to buy a pair of shoes in order that he can stamp more vigorously at the huapango. The male onlookers participate in the music by singing in a high falsetto as the dance continues. Each huapango tune has an unlimited number of verses and new ones appropriate to the occasion are continually improvised by the singers.

Order is maintained at the dance by the local police force, who patrol the dance floor with their ancient rifles slung on their backs. Any disorder or incipient fight is quickly and tactfully suppressed by these efficient guardians of the law, who are elected by popular vote and receive no pay

Photograph by Matthew W. Stirling

A CROSS SECTION THROUGH AMERICAN PRE-HISTORY

This exploratory trench through Mound B of the Ranchita group of mounds illustrates the method of determining the construction of these earthen structures. Successive additions to the mound are disclosed. Pottery and other specimens from the different levels are carefully segregated in order to determine what cultural changes took place.

except the privilege of carrying a rifle.

On week ends when the south wind was blowing, as we lay in our cots at camp we could hear the music and the stamping of the dance continuing until dawn. From our point of view the only drawback to these social affairs was the return of visiting delegations, who, stimulated by more than the music, frequently passed the trail by our camp, shouting and firing their guns in the air from overabundance of spirits.

Our workmen, most of whom took part in these dances both Saturday and Sunday nights, nevertheless always appeared on time on Monday morning evidently none the worse for 48 hours of continuous activity.

For the sake of variety and out of sheer sociability, music for these dances was provided by various orchestras recruited from neighboring villages. These visiting orchestras, on passing our camp, would always stop to serenade us, a friendly custom that did much to relieve the routine of camp life (page 205).

Next to the huapango, the greatest source of entertainment on week ends was a visit to the camp to watch us eat. Groups came before breakfast and stayed through dinner, men, women, and children. We never quite decided the cause for the attraction—our strange table manners, such as eating rice and beans with a fork instead of a knife; the astonishing sight of two women sitting at the table and eating with men; or the unbelievable quantity of food which we consumed.

POEMS OF A BUTCHER-BARD

Very few of the local natives had had the opportunity to learn to read and write. One exception was the village hog butcher, who combined with his profession a knack for poetry.

Whenever some significant event took place in our camp, such as the arrival or the departure of a member of the expedition, or the unearthing of a new monument, Damaso would appear at camp bearing a lengthy poem which he had composed to celebrate the occasion.

These poems are known as *corridas* and are intended to be sung in much the same fashion as the ballads of old England.

WHAT OTHER SECRETS OF AMERICA'S YOUTH MAY LIE BURIED BENEATH THIS MOUND?

Here was uncovered Stela C, which bears the earliest date yet found recorded in the Western Hemisphere (page 212). Since the dated fragment of stone is obviously broken from a large stela, other fragments may come to light when the mound is further investigated.

Damaso was the father of Valvina and he took this as the only means at his disposal for expressing his appreciation of our giving his daughter the opportunity to earn some money.

HONEY FROM STINGLESS BEES

All of our workmen likewise felt grateful for the money that we brought to the community and we were frequently recipients of such presents as they were able to provide, sometimes corn or squash, a grass for making tea, a few eggs, homemade cheese, or a bottle of honey from the stingless bees.

The local house builder who supervised the construction of our camp maintained an apiary of these interesting insects. The stingless bee is a native chiefly of Middle and South America. Both the wax and the honey were greatly prized by the ancient inhabitants of the region and ranked among the principal trade articles of the Maya. The honey is somewhat thinner than that to which we are accustomed, but it has a delicate and delicious flavor.

It is the custom among the women of Tres Zapotes to wear flowers in the hair. Each morning when María and Valvina arrived in camp to begin their duties for the day, they brought flowers for Mrs. Weiant and Mrs. Stirling, who were thus literally compelled to adopt this decorative habit. This type of thoughtfulness was typical of most of the village.

One of our workmen thought that in view of the isolation of our camp we should have a watchdog, and, suiting the action to the word, he brought us one morning the best of a litter. In this manner Lobo became a member of our expedition.

Lobo soon won his way into the affections of all of us with his puppy loyalty, even though his own vigorous demonstrations of affection frequently smeared freshly laundered trousers with mud. His frequent excursions into the brush made him a wonderful collector of ticks and pinolillos, which he distributed lavishly around the household.

"LOBO" BRAVE EXCEPT IN EMERGENCY

It must be confessed that Lobo's intelligence left something to be desired, but his goodwill and affection were entirely beyond doubt. His courage too was somewhat

EARLY AMERICAN DOGS WORE COLLARS—BUT NO LICENSE TAGS!

The figurine may have represented the favorite pet of some ancient Tres Zapotean buried in the Ranchita site. Several distinct types of dogs were represented in the clay models uncovered, but this is the only one in which a dog collar is represented.

WHAT WERE THESE "YOKES" USED FOR? AS COLLARS FOR SACRIFICIAL VICTIMS?

No one knows the real purpose of the beautiful objects carved from hard, fine-grained stone and highly polished. The one on the left is a conventionalized frog, while that on the right probably represents the mouth of a jaguar. They are called "yokes" because it was once believed they were placed around the necks of persons about to be offered to the gods.

A LOCAL BAND SERENADES THE AMERICANOS ON SUNDAY

Even the tiniest village has its orchestra. In addition to such store-bought instruments as concertinas and cornets, the players beat homemade drums and traps fashioned from gourds and turtle shells, one of which appears in the right foreground (page 202).

open to question. He took his duties as camp guardian very seriously and was extremely bold when it came to barking at the heels of passing women and children, but he managed to acquire a studied interest in birds and insects when strange men invaded the camp.

His principal amusement during the day was in bedeviling the cows that grazed near the diggings. Lobo often seemed amazed at his own temerity in chasing these huge crossbred zebu cattle, but he promptly turned tail whenever one stopped to face him.

In spite of all this, it was not easy to leave Lobo behind when our field work came to an end.

To avoid the necessity of keeping considerable sums of money in camp, we arranged with the local storekeeper to pay off our crew and we furnished the workers with typed pay slips which were made out daily as the pay roll changed. Each morning it was Weiant's task to call the roll and each evening to distribute the pay slips.

All of my correspondence I dictated to Mrs. Stirling on the typewriter. The operation of the typewriter, particularly in the early part of the expedition, created considerable interest on the part of the natives, who gathered around the doorway to watch this entertaining operation.

I felt that the local citizenry must be pretty well impressed by my importance in thus having all such tasks done by others. One day, however, Valvina in a confidential mood turned to Mrs. Stirling.

"How unfortunate," said she, "that your husband never learned to read or write!"

LARGE CITY ONCE FLOURISHED HERE

The first week in camp was filled with interest. We began immediately the work of excavating the Colossal Head, which lay

Photograph by Alexander Wetmore

ERODED TRAILS SERVE AS HIGHWAYS

An occasional bullock cart is driven over this road near Tres Zapotes, but for the most part it is traversed by natives on foot or riding mules or steers. Along such trails natives drive pigs to market, or carry chickens or bundles of wood for fuel. When a man and his wife travel together, the wife usually walks and carries the burdens, while the husband rides.

not more than 100 yards from our camp. At the same time we started a trench through the mound immediately back of our house.

A portion of each day was devoted to exploration work, and it was not long before we realized that the site we had selected marked the former location of a great aboriginal city. More than fifty mounds were found in an archeological zone which stretched along the Arroyo Hueyapa for more than two miles.

Some sections of this area were exposed as the result of recently cleared *milpas* (clearings for planting); other sections were densely blanketed with tall tough grass, marking the location of abandoned cornfields. Still other mounds were cloaked with jungle. Because of this fact, even the examination of the surface of the zone presented a difficult task.

At first, through information from the milperos, we were led to a new monument almost every day until nine in all were located.

Many were the stories we heard about the Colossal Head. We were told that years before, treasure hunters had found much gold around it. The breast of the figure had been exposed and two alligators

Photograph by Matthew W. Stirling

JUNGLE ALTERNATES WITH OPEN AREAS NEAR TRES ZAPOTES

All the materials for house building—timbers, palm, and vines for ties which take the place of nails—come from such dense growths. Farmers of Tres Zapotes follow the ancient Mayan methods of agriculture. First they cut and burn the tangled growth; then they plant corn, squash, and beans in holes dug with a pointed stick. Since they seldom plow the land, grasses and bushes soon grow up, crowding the vegetables. When this occurs, the garden plots, or *milpas,* are abandoned and new areas cleared (page 198).

were reported carved upon it. In addition, we learned that it was impossible to photograph the head, because it always turned around on the film and only the back would show!

Although we were rather skeptical of some of these details, nevertheless our interest was intense as we slowly cleared the great object of the heavy clay in which it was interred.

With a crew of twenty men the work of exposing the monument did not take long. On the second day our queries were answered. Carved from a single massive block of basalt, the head was a head only, and it rested on a prepared foundation of unworked slabs of stone. At the level of the foundation was a hard-packed clay floor, demonstrating that despite its enormous weight the head had not sunk into the earth but had been buried by erosional processes (pages 185, 187).

TEN-TON HEAD INSPIRES AWE

Cleared of the surrounding earth, it presented an awe-inspiring spectacle. Despite its great size the workmanship is delicate and sure, the proportions perfect. Unique

SUGAR CANE IS CANDY TO TRES ZAPOTES FOLK

They chew it raw, make molasses from it, and distill the juice to *aguardiente,* Mexican "moonshine."

THIS CLAY MASK REPRESENTS THE DOUR FEATURES OF SOME DEPARTED RESIDENT

The purpose of the clay faces is unknown. Possibly they were associated with a cult of the dead.

A TROPICAL DARKROOM OF PALM THATCH

Richard H. Stewart, National Geographic photographer attached to the expedition, ran into some difficult problems. Because palm thatch was the only available building material, light could not be excluded for daytime work, and all developing had to be carried on at night. An assistant outside, eying a watch illuminated by flashlight, announced "time up" when the period for development had been reached. All the photographs accompanying this article were processed here.

in character among aboriginal American sculptures, it is remarkable for its realistic treatment. The features are bold and amazingly negroid in character.

Fully exposed to view for the first time in modern times, it still remains as great a mystery as ever, for it fits into no known aboriginal American cultural picture. Approximately 6 feet high and 18 feet in circumference, it weighs over 10 tons.

How was this great block of stone transported more than ten miles from its source near the base of Mount Tuxtla? This problem, which would tax the ingenuity of an engineer with the benefit of modern machinery, included crossing the 30-foot-deep gorge of the arroyo. The ancient engineers, however, performed the feat of successfully quarrying a flawless block of basalt and transporting it in perfect condition without the aid of the wheel or domestic animals.

This was not the only huge stone that had been transported, carved, and erected by these ancient people. At the base of a mound a half mile from our camp we found a great stela, fallen on its back and broken into two pieces of approximately equal size. When we later excavated this monument we found that it measured more than 17 feet in length, almost 7 feet in width, and averaged 20 inches in thickness.

This stela may have fallen while the site was occupied by the people who erected it, or possibly by a later group. In the process of excavation we discovered that all around the edges of the fallen monument had been packed thousands of razor-edged obsidian flakes, evidently placed as offerings. Our workmen believed that these were lightning bolts and advanced the theory that the stela had been knocked down and broken as the result of being struck by lightning.

FIGURE HOLDS A HUMAN HEAD

Because it fell face up, the sculpture on this interesting stone is very badly weathered, but the principal elements can still be distinguished. The figure of a man carved in almost full relief occupies the central position of the main sculptured area (page 200). On either side facing him are

MARÍA'S MOTHER STIRS THE CHICKEN FOR SUPPER

On such a primitive stove, consisting of a large wooden box filled with sand on which rests an iron hoop with three legs, was prepared the simple fare for the expedition members. Menus were not much different from those of the natives—chicken, local beef and pork, beans, and rice, with tortillas serving as bread for nearly every meal. Cooking utensils are of earthenware (page 199).

two other figures of equal size but carved in low relief. One of these holds, suspended from his hand, a human head. Above these figures is the great masklike face of some deity of the ancient people.

The two fragments of this monument were too heavy for us to turn over, but, realizing that if there were carving on the back it should be well preserved from weathering, we determined to run tunnels under the stone. This was done and the back was found indeed so perfectly preserved as to be almost polished—but, sad to relate, it was completely devoid of decoration. How the ancient sculptors could have resisted the temptation to do something with that great expanse of smooth stone still perplexes me.

This was the first stela that we discovered and was much the largest of any at the site, so we called it Stela A.

Almost due east of this monument was an elongated mound, at the base of which projected a few inches of the broken edge of a stone box. One of these exposed sections displayed elaborate carving, so we soon brought a crew to expose it.

The result of this small piece of excavation surpassed our fondest expectations, for the stone box when revealed, even though incomplete, represented not only the finest piece of sculpture from the Tres Zapotes site, but one of the finest examples of stone carving ever found in Mexico.

SCENES OF COMBAT CARVED IN STONE

The box is five feet in length, the sides sloping somewhat so that the area of the bottom is smaller than the top. The exterior of each of the four sides is covered with extremely intricate and beautifully executed carving in high relief. Elaborate scroll designs are blended with a number of human figures or, what is more likely, gods engaged in cosmic combat.

The features of the gods here represented

UNDER A LEAKY THATCH ROOF, DISTINGUISHED SCIENTISTS ARE ENTERTAINED

Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution, is seated at the left. Beside him, partly hidden, is Matthew W. Stirling, Chief of the Bureau of American Ethnology, Smithsonian Institution, and leader of the expedition, and next is Engineer Agustín García. At the end of the table are Dr. and Mrs. C. W. Weiant. The smiling gentleman is Dr. D. Juan Valenzuela, a well-known Mexican archeologist. At the extreme right sits Karl Ruppert, of the archeological staff of the Carnegie Institution of Washington. Eating customs and strange implements of the archeologists fascinated the natives, one of whom stands in the background.

are strongly Mayan in feeling, but the nature of the remainder of the carving is unique (pages 195, 196).

BASIN USED IN HUMAN SACRIFICE

A few feet from the box, part of another stone was seen projecting above the ground. This, when excavated, proved to be a barrel-shaped piece of basalt, flat on the bottom and with a shallow basin on top. It was about two and a half feet in height and in all probability was a stone used for human sacrifice (page 194).

By analogy with what we know of Toltec custom, we believe that the sacrificial victims were placed over this stone where their hearts were torn out. The blood drained into the basin was then transferred to the stone box, as the most precious offering mankind could make to his gods. That human sacrifice of this nature was practiced in this section of Mexico at the time of the first arrival of the Spaniards we know from the accounts of Bernal Díaz and others.

For the sake of drama, the climax of an archeological expedition, as of anything else, should come toward the end, but in the case of our expedition we had been in camp only two weeks when the big moment arrived.

IN ARCHEOLOGY IT PAYS TO "LEAVE NO STONE UNTURNED"

Already more than pleased at our good luck and with the slogan of "leave no stone unturned," I started out on the morning of January 16, 1939, to the most distant section of the archeological zone, two miles from our camp. The purpose of this particular excursion was to turn over a flat stone that had been pointed out by one of

"NOVEMBER 4, 291 B. C.," SAY THESE BARS AND DOTS

This is interpreted as the oldest date ever found recorded in the Western Hemisphere. It represents a period a generation before Rome and Carthage began the Punic Wars. Pointing to the hieroglyphs is E. G. Cassedy, artist of the Bureau of American Ethnology, Smithsonian Institution.

Photograph by Matthew W. Stirling

THESE CARVINGS MAY BE A "DOUBLE CHECK"

On the reverse face of the famous Stela C (above), on which is carved the earliest recorded date in America, appear these badly weathered designs (opposite page). In the opinion of Dr. Alfonso Caso, noted Mexican archeologist, they represent the tear-streaked face of a deity related to Cocijo, the ancient Zapotecan rain god. Perhaps the carvings will be additional proof that the date is that on which the monument was set up (page 203).

our workmen a few days before. It had the proper shape for a stela and I had high hopes of finding carving on the other face.

It was a very hot day and the twelve workmen I had with me labored mightily with their wooden poles before the heavy slab could be turned. Finally this was accomplished, but again came disappointment; both sides of the stela were perfectly plain.

I remembered, however, that the guide two days before had pointed out another stone near by, a few inches of which projected above the surface at the edge of a tiny milpa owned by a native with the rather surprising name of Santo Sapo. This milpa was in the level area at the base of the highest mound in the entire Tres Zapotes zone. The stone was so inconspicuous that had I not been in the vicinity for another purpose I should scarcely have thought of excavating it.

As the digging proceeded, it developed that the stone was larger than I had thought and that it had definitely been worked. On the south face traces of a weathered design in low relief began to appear, but the back of the stone appeared to be plain.

A MONUMENT WITH NUMBERS!

Finally, at a depth of three feet in front, the workmen struck another stone. This, when carefully cleared, proved to be a perfectly flat altar, roughly circular in form but with unworked edges. The existence of this altar definitely showed that the first stone had been erected as a stela and was still in position as set up.

Try as I might, I could distinguish no pattern in the weather-beaten carving on the face of the stela. Thinking I might as well complete the job I had started, I instructed a couple of the men to finish exposing the back of the stela where we had stopped work when the altar was found.

As the men had been cautioned against scarring the monument with the tools, they were on their knees in the excavation, cleaning the mud from the stone with their hands, when one of them spoke up in Spanish:

"Chief! Here are numbers!"

And numbers they were indeed; I don't know how my illiterate workman guessed it, but there, running transversely across the back of our stone, was a beautifully carved row of bars and dots in the form of a Maya calendrical date (opposite page). Here in front of my eyes was the thing we had all secretly hoped might show up in the course of our work, but which not one of us had had the temerity to expect.

It was obvious that the stone in front of me was a fragment broken from the middle of a large stela on which the date had been originally carved. This fragment had been broken off and re-used by the people who had placed it in position as we found it.

It was also apparent that the original stela had fallen on its back and lain in that position for a very long time before being broken up by a later group, for, although the stone is extremely hard, the face had become much weathered, while the back containing the date was scarcely weathered at all.

Through a remarkable piece of good fortune, when this piece was broken off almost all of the date was on this particular section.

NEW WORLD'S EARLIEST RECORDED DATE

Under the broiling sun I copied the characters and hurried back to camp, where we settled down to decipher them. Before long our calculations were complete. Our date was 6 Eznab 1 Uo of the Maya calendar. Using the day by day correlation of Dr. Herbert J. Spinden, this is equivalent to November 4, 291 B. C., which represents the oldest recorded date ever found in the New World—193 years earlier than the Tuxtla Statuette (page 183).

The style of the date on Stela C, for thus it has been designated, resembles more closely that of the Tuxtla Statuette than any other known Maya date. The design carved on the other surface of the stela represents, according to the distinguished Mexican archeologist Dr. Alfonso Caso,* a very early form of the rain god.

These facts, combined with the ancient weathering and re-use of the monument by a people who were themselves probably contemporary with the classic period of Maya civilization, convinces the writer that the probabilities are all in favor of the fact that the date actually represents the time at which the original stela was erected. The definite establishment of this fact, however, constitutes an interesting problem.

It was not difficult to visualize the ancient sculptor at work upon this monument,

* See "Monte Albán, Richest Archeological Find in America," by Alfonso Caso, NATIONAL GEOGRAPHIC MAGAZINE, October, 1932.

UP THIS STONE STAIRWAY CLIMBED ANCIENT PRIESTS

While excavating a small mound, the archeologists were surprised to find a rectangular platform faced with stone masonry unbonded by mortar. A steep stairway of four flights led to the top. This was the only example of stone architecture discovered during the excavations.

recording, no doubt, some occasion of great importance to his tribe. One imagines that the design on the face of the stone was first completed, representing the god to which the monument was dedicated.

WHAT TALES THIS STONE COULD TELL

Then, while gaily bedecked priests and astronomers looked on, the sculptor outlined the glyphs and numerals on the back by abrading grooves around them with his stone tool.

When the proper depth had been reached, the remainder of the surface of the hard stone was painstakingly ground down by the same method until only the glyphs and the bars and dots stood out in sharp, low relief.

The stela was erected and probably stood for a long time, an object of admiration and veneration and a center of religious ceremonies.

Eventually misfortune overtook the tribe or they migrated to other lands. The stela fell on its back, where it lay until, centuries later, another group of people came to occupy the site.

Finding this massive relic and with little respect for the gods of their predecessors, they broke the great stone into several pieces of a size that they could more easily handle. The middle fragment bearing the date, being wider than it was long, they set up on one edge in front of a great stone altar, where once more, serving different gods, the stela looked out on strange ceremonies.

DECIPHERING DATE WAS EXPEDITION'S GREATEST THRILL

Time passed, the city was again abandoned, and gradually Nature buried the monument with its altar so that it all but disappeared from sight, until just now our spades have brought it to light.

The Maya calendar, like our own, indicates dates by marking periods of time reckoned from a fixed point in the past.

THE EXPEDITION'S EQUIPMENT ARRIVES BY OXCART

The last leg of the journey to Tres Zapotes was a 10-mile overland trip. Beyond the zebu oxen is the thatched structure which served as dining room, kitchen, and workshop.

BULLOCKS TAKE THE PLACE OF AUTOMOBILES FOR TRES ZAPOTES LABORERS

While many of the workers came to the excavation site on foot, the more opulent rode into camp on saddled steers which they "parked" while they worked. The mount is guided by the nose ring.

OLD-MAN-OF-THE-MOUNDS

Such faces in baked clay probably represent important deities of the aboriginal inhabitants of Tres Zapotes. The specimen was found in Mound F at the Ranchita site and shows unusual skill in the modeling. It formerly decorated the rim of a large urn.

Just as we start our calendar from the birth of Christ, the Maya begin theirs with the date of 4 Ahau 8 Cumhu (about 5,000 years ago), which must have marked some event of tremendous significance to them in their mythologic history.

HOW THE MAYA MEASURED TIME

In order to record the time that has passed up to the date desired, the Maya used five time periods, each of which is written down. These are the Baktun, the Katun, the Tun, the Uinal, and the Kin. They represent, respectively, time periods of 144,000 days, 7,200 days, 360 days, 20 days, and 1 day.

Thus a Maya date recorded as 9 - 12 - 6 - 5 - 16 would represent 9 periods of 144,000 days, 12 periods of 7,200 days, 6 periods of 360 days, and so on, the sum of which would indicate the number of days that had passed since the beginning point of 4 Ahau 8 Cumhu.

This is much as though we would indicate August 1, 1939, by writing 19-3-9-7-1, meaning 19 periods of 100 years each, 3 periods of 10 years each, 9 periods of 1 year, 7 periods of 30 days, and 1 period of 1 day. If our months were all 30 days in length and all periods were translated into terms of days, we could thus indicate our dates in about the same form as the Maya, showing the time elapsed since the birth of Christ.

In writing their numbers, the Maya used a system of bars and dots, a bar indicating 5 and the dot 1.

Biggest thrill of the expedition came when Mrs. Stirling, who was making the calculation, arrived at the conclusion and we saw that the date was 6 Eznab 1 Uo, or November 4, 291 B. C., by the Spinden correlation.

If three inches more had been broken off either the top or the bottom of the monument, the date never could have been determined.

This find was the high point of our season, but the work went on. We discovered the site of the ancient cemetery where we obtained a rich collection of beautiful figurines and pottery vessels.

TWO DISTINCT PEOPLES DWELT HERE

Here we found evidence of the occupation of the site by two distinct peoples. In the black humus soil near the surface were cremated burials, the charred bones having been placed in pottery vessels which were always carefully covered. Deep below these were direct inhumations with offerings consisting of an entirely different type of pottery. We do not believe, however, that this older culture represented in the cemetery site belongs to the people who carved Stela C, as the people who re-used that monument had this same type of ceramics.

Photograph by Marion Stirling

THE EXPEDITION'S MOST INTERESTING PRIZE TRAVELS WITH A SCIENTIFIC ESCORT

The dated monument is on a launch bound downstream to Tlacotalpan and thence to Mexico City, to be placed in the National Museum there. On the right, facing the camera, is Mr. Stirling. Dr. Wetmore, wearing dark glasses, sits on the rail to the left. Standing, facing the stone, is Ricardo Gutiérrez, the storekeeper of Tres Zapotes and owner of the launch.

As a result of the large shard collection obtained, we hope eventually to establish a detailed chronology for the site, which may then be tied in with other known archeological centers of Middle America. This will, in fact, represent the most important scientific result of the expedition.

For almost four months the camp by the Colossal Head was our home. There were periods of heavy rain and mud when cold northers swept down upon us, halting the work and filling the excavations with water which had to be laboriously bailed out again (page 200). More often the sun shone as the steady south wind dried the ground.

When Dr. Alexander Wetmore, Vice-Chairman of the National Geographic Society's Committee on Research and Assistant Secretary of the Smithsonian Institution, arrived with Richard H. Stewart of The Society's photographic staff, a new

THE EXPEDITION'S BRIDE AND GROOM SET UP HOUSEKEEPING IN TROPICAL SIMPLICITY

This young couple was married while the expedition was at work at Tres Zapotes. The bridegroom was one of the laborers. The house of palm "timber" is oriented with its ends pointing in the direction of the prevailing winds.

house was built including a palm-thatched darkroom for Mr. Stewart and a workroom where Dr. Wetmore prepared and stored his bird skins. Shortly after this, E. G. Cassedy, our artist, appeared with his drawing materials and our personnel was complete (pages 209, 211).

There was little time for leisure and the busy days passed quickly. There were excursions to El Mesón and to Lirios to view other groups of mounds. There was constant cataloguing and packing of specimens. There were serenades and Sunday visitors, many of whom had traveled two days to see our exotic establishment.

GIANT HEAD STILL HOLDS SECRETS

They were interested in our well, our cement floors, and our clothing. They went to see the head and some of the other nearby monuments, but most of all they liked to gather by our porch to watch us eat. Many left us flowers and other little gifts and we reciprocated as best we could with empty tins and old magazines, the pictures from which were in much demand.

But all things must end. Our departure was set for April 15. The night of the 14th almost the entire village came to our camp for a surprise farewell serenade. With two orchestras, one for the huapango and the other for the fandango, the party lasted until the early-morning hours when we bade our farewells to these kindly people who had become our friends. Before the sun was up, we left our camp at the foot of Mount Tuxtla.

Like a great American Sphinx, the Colossal Head, newly cleared of the imprisoning earth, still looks imperturbably toward the north across the abandoned plaza where once barbaric ceremonies were performed. Could his great mouth but speak, one of the most important chapters of American history would doubtless be revealed to us.

FLOWER PAGEANT OF THE MIDWEST

From March to November Nature Embroiders an Ever-changing Pattern of Living Color

By Edith S. and Frederic E. Clements*

With Paintings and Biographies of 125 Flowers by Edith S. Clements

EARLY on a brilliant May morning in 1811, John Bradbury clambered up a steep bluff of the Missouri River just above the mouth of the Platte and looked westward over the prairie, which stretched in swelling waves as far as the eye could reach.

Both botanist and intrepid explorer, he had set out from England two years before to discover plant novelties for public gardens, at a time when the flowers of the prairies were still little known.

Now he viewed the spring display at the height of its color, set against the intense verdure of the grasses and forming a kaleidoscope of many-hued blossoms spread over Nature's vast palette of green.

On the cooler slopes, anemones in pink and blue swayed in the wind, and buffalo plums like purple shadows lingered past their season. The warmer hillsides were mantled with a mosaic of violets, phlox, puccoons, false indigo, and spiderworts mingled freely or clustered to deepen each varied tint.

A BOTANIST'S PARADISE

Bradbury was profoundly impressed by the grandeur of the view with its endless undulations and declared that he had never seen a landscape to match the prairie in beauty, however much embellished by art. He expressed the belief that the prairies would become one of the most beautiful countries in the world. To those who saw them at a later time, but before the period of general settlement, his praise seemed in no wise extravagant.

Spring comes unheralded to the prairies, since the first diminutive harbingers are scarcely to be perceived among the crowding shoots of grass. These are red-brown dwarfs fitted to brave the chill breath of March as they snuggle close to the warm earth out of reach of late winter's blasts.

First to peep forth are the tiny primroses and whitlows, followed soon by pussytoes, anemones, and tuliplike pasqueflowers, and then by prairie fennel sprawling over warm sandy slopes.

In neighboring woodlands of oak and hickory, the first blooms of snowy wake-robin, varied hepaticas, white and yellow adder's-tongues, and the blushing rue anemone waken to throw off their blankets of leaf mold, and the trailing arbutus distills the magic of its evergreen leaves in fragrant bells.

A SEASON-LONG PARADE MARCHES BY

These forerunners meet few rivals for the favor of early spring and they rapidly extend their pure or blended colors over wooded dell and hillside. With an auspicious start, all of the first-comers gather such momentum as to carry them well into the throng of spring bloomers during April and May.

April on the prairie is ushered in by spreading troops of slender windflowers in blue and white and sturdier pasqueflowers in rougher coats well suited to northern climes. Shooting stars may accompany them in serried ranks, and on the flanks the yellow parsley marches along the ridges.

As the sun's rays strike more directly, birdsfoot and larkspur violets with golden buttercups press in throngs over meadow and hill slope, and violet oxalis and trailing strawberries hide among the clumps of grass. Marsh marigolds brighten moist lowlands and bogs, while spiderworts and blue-eyed grass enliven meadows with blue and rose, dotted with the gold of starworts.

May arrives with the advent of warm days and tall plants of yellow false indigo hang out their long racemes and blend colors with the orange and yellow of the puccoons, in vivid contrast to the pink phloxes which bejewel the curving swales and gentle slopes.

* See "The Family Tree of the Flowers," by Frederic E. Clements and William Joseph Showalter, and "Wild Flowers of the West," 206 illustrations in color by Edith S. Clements, both in the National Geographic Magazine for May, 1927. See also *The Book of Wild Flowers*, published by the National Geographic Society, $3 in United States and Possessions, elsewhere $3.25.

Most striking of all are the pentstemons, or beardtongues, some of them with stems taller than a man and bearing purple or lavender flowers often two inches long. On the rougher slopes and ridges grow shrubby groups of yucca or Spanish bayonet, with rosettes of stiff, erect leaves crowned by long spikes of nodding lilylike flowers.

While the spring pageant of color has been passing across the prairie, a quieter display of great charm has accompanied the leafing out of the woods. Wake-robin, adder's-tongue, and their companions have been joined by other forest dwellers, all intent on making the most of the sunshine before the leafy canopy blots it out.

Among the forest dwellers are the best-loved flowers of spring, many of them white or delicately shaded with pink—spring beauty, bloodroot, dutchman's-breeches, squirrel corn, false Solomon's-seal, and several trilliums. Color in this charming ground cover is provided by blue and yellow violets, bellworts, rue anemone, lady-slipper, showy orchid, Jacob's-ladder, the mottled jack-in-the-pulpit and green dragon, and the pink and purple wake-robins.

The pattern is rendered more vivid by masses of blue phlox, rose-red geranium, and brilliant patches of scarlet and yellow columbines. The giants of the springtime tower above their humbler companions in the form of wandlike blue larkspurs, blue cohosh, meadow rues, and Solomon's-seal.

COLOR FLOODS THE PRAIRIE

On the warm prairie the season anticipates the calendar, and many of the blossoms of spring yield to the onrush of summer before May has departed. The grasses have stretched up and some are in bloom, so that the flowers pollinated by insects must strive to overtop them in order to be seen by bee and butterfly.

For the same reason it is desirable to mass color and to reinforce it to some degree by fragrance. Plants of lowly stature are unable to make headway against their taller competitors and must take the role of underlings or seek opportunity in drier or more open places. In this aspect, members of the pea family give the dominant note, modulated by certain composites.

Chief among the peas is a group of close relatives: lead plant, psoralea, dalea, prairie clovers, together with indigo plant, false indigo, goatsrue, vetches, locoweeds, tick trefoils, and licorice.

The visible pattern is woven of these, with the purple-and-old-gold lead plant and flowery psoralea rivaled in number only by the snowy sheets of prairie daisy drifted across slope and ridge. Embroidered upon this are broad bands of prairie clovers, pink and white over the hillsides, and the rose-colored clusters of wild bergamot in the meadows, often blended with the white of anemones and prickly poppies.

Striking contrast is provided by some of the most brilliant flowers of the prairie, notably the blue false indigo, the purple coneflower, the butterfly milkweed, burnt-orange in color, and the prickly pears in yellow, rose, and dark red.

Below the canopy of bloom may run the flaming hue of the rose gentian, or centaury, the sky blue of the Venus's-looking-glass, or the varied yellows of the flaxes.

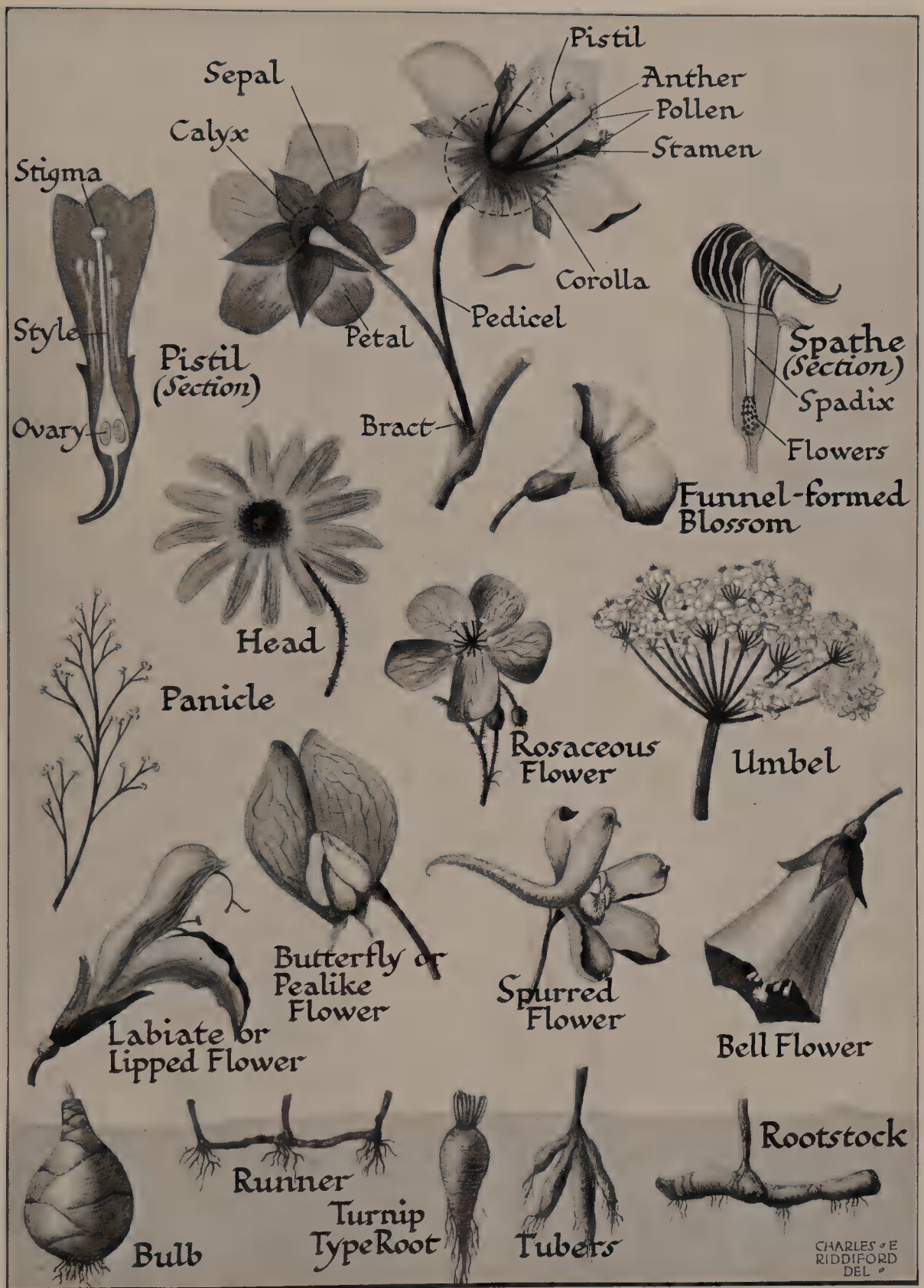
A hint of autumn is to be seen in the many yellow blossoms, most of them claiming kinship with the sunflower. Conspicuous among these are the several coneflowers, the most familiar being the black-eyed Susan, those intelligent giants the compass plants, the oxeye and early-blooming sunflowers, coreopsis and the closely related bur marigolds or tickseeds.

PRIMROSES SIX INCHES ACROSS

On dry or rocky hillsides or in open borders are dotted thickly the golden cups of evening primroses often six inches across, and near by may be seen the rose-and-gold balls of the wild sensitive brier or the orange-yellow masses of the sensitive plant.

Midsummer in the woods is the season of deep shade, which is usually less favorable to number, size, and color in flowers. Bright flowers are to be seen in openings, beneath sun-flecked canopies, and along streams and borders, but where shadows lie heavy, coarse weeds with small white or green blossoms abound. Such are the wood and false nettles, goosefoots, pokeweed, snakeroot, and sweet cicely, or the lowly bedstraws, clearweeds, pellitories, and three-seeded mercury.

Most charming of the shade plants are the yellow-and-orange jewelweeds, or touch-me-nots, with glistening leaves and jack-in-the-box pods. They also deserve the favor of garden lovers, which has fallen instead upon the red bee balm, the rose dragonhead, and to a less extent upon the tall bellflower, the giant hyssops, and the skullcaps.



TYPES AND PARTS OF FLOWERS

Whatever form the orthodox flower takes, it is an assemblage of four parts—stamens, which produce the fertilizing pollen, tipped by anthers; pistils, which receive the pollen in the stigma and conduct it into the ovaries, where it fertilizes the seed produced there; petals, that form the corolla, which acts as an advertisement to be read by the pollen bearers; and sepals, which form the calyx, whose main task is to shield the delicate machinery. It has been by the modification of these four parts of the flower, whether by the change in the numbers of stamens, pistils, petals, and sepals, by changes in their respective shapes, or even in their respective tasks, that the thousand and one familiar forms of flowers have come to us.

The ubiquitous pea family is represented by a number of tick trefoils and bush clovers, but of greater interest are the trailers, the groundnut with its brown-purple clusters and sweet tubers, and the wild peanut, which ripens some of its fruits underground, as does its namesake.

Late summer and autumn make heyday for the asters, goldenrods, sunflowers, and their many kith and kin. The advance guards appear in the prairie by the middle of summer, but in August composites take possession of the landscape to hold it until they yield to the frosts of oncoming winter. In stature the leaders are sunflowers, compass plants, and rosinweeds, some of them much taller than a man, and sunflowers, goldenrods, and asters vie with each other in number of species and masses of bloom.

Yellow is the pervading tint, but it is varied by the blue and rose of asters and the purples of ironweeds and blazing stars. The most distinctive note in this symphony is given by the blue sage, which rivals the sunflowers in height and like them graces the long Indian summer. Of equal beauty are the late gentians, blue lobelia, the ruellias and gerardias, but these are mostly hidden away among the grasses.

In the autumn woods, asters and goldenrods hold almost complete sway, disputed only by occasional groups of sunflowers, crownbeard, boneset, or Indian plantain. The only worthy rivals are the thoroughworts and their sinister cousin, the snakeroot, which spreads a snow-white mantle through its favorite woods.

Throughout the prairie, the grasses are the solid citizens of the community, exercising the general direction of affairs but caring little for publicity. In the forest, on the contrary, the trees are as conspicuous as they are controlling, and all other members of the community must adjust themselves to the demands of these feudal overlords. In the one, grass and herb avoid the clash of competition as far as possible; in the other the issue has long been decided in favor of the trees, the shrubs representing a middle class and the herbs a lower class.

STRUGGLE FOR WATER AND SUNLIGHT

In both prairie and forest there is a frequent or constant scarcity of water, raw mineral materials, or power in the form of sunlight, and the struggle for these limits the co-operation that every community must maintain to some degree.

Three families of flowering plants take precedence over all others in the prairie community. As is to be expected, the reigning family is that of grasses, while the distinctive societies of the seasons are organized chiefly by peas and composites, with roses, buttercups, lilies, snapdragons, and mints less prominent among the elite.

In the forest the grasses sink to an unimportant level and the ruling group is drawn largely from the oak and hickory families. The aster family is less distinguished and the lilies much more abundant.

PARENTAL SOLICITUDE IN PLANTS

Strikingly unlike as they are in stature and general appearance, the pre-eminence of oak, hickory, beech, and chestnut in woodland, and of spear grass, dropseed, bluestem, and wheat grass in prairie is due mainly to family pride, which leads them to give their offspring the best possible start in life. This consists in storing a large supply of food in the seed for the tiny plantlet and in providing the latter with a thick coat, and sometimes a sweater also, to guard it against buffets of weather.

So well has this been done that man has come to appropriate the food supply in grass seeds for his own use as flour and cereals, and has done much the same in a smaller way with various kinds of nuts.

Peas and sunflowers employ a similar method for starting their offspring out in the world, but with somewhat less concern and hence less complete success.

Parental solicitude for the helpless offspring must begin long before the seed is formed. The foremost families have learned to limit the number of seeds to a single one for each flower, an advance brought about by the need to conserve material and energy through division of labor.

In the peas this has been done in the traditional way by dividing the work among the brightly colored petals, though this has required a wide departure from the custom of their ancestors, the roses. In place of five petals, each a "jack-of-all-trades," one is set aside as a banner to attract insects, or as a landing platform for their convenience. Two other petals are soldered together in a keel to protect pollen and nectar.

This specialization is still somewhat imperfect in its results, for most peas still produce pods with several seeds, and only a few, such as the most important prairie species, bear flowers with a single seed.

The asters, goldenrods, and sunflowers all limit the work of each flower to the production of one seed, and their great success seems to be due mostly to close co-operation among the florets of the flowerlike head.

"ALL FOR ONE, ONE FOR ALL"

As already suggested, the head is actually a socialized group in which each kind of floret or part has its own special task and in which waste is all but eliminated.

In the dandelion, for example, the original green calyx has become useless and is converted into a parachutelike device for air travel. Grass flowers have likewise taken on the social habit and have banded themselves together in small but efficient groups.

However, the trees of our deciduous woods have lagged behind in their social organization, the catkins of pussy willow, birch, and oak having developed little feeling for co-operation.

At first thought, it appears strange that plants with brightly colored corolla should be the conservatives of the floral world and the grasses and trees with insignificant green flowers the progressives. This is quite at variance with man's interest in flowers, which often ignores the existence of flowers in grasses and our common shade trees.

FLOWERS USE "COLOR ADVERTISING"

Peas, asters, roses, and lilies, like nearly all other treasures of field and garden, have remained faithful to the practice of their buttercup ancestors, which were the first to turn to color advertising of their wares. This custom has been preserved by the large majority of flower families, though nearly all have improved upon it in one or more details.

However, this adherence to tradition appears to have been more a matter of necessity than of choice, and attempts to break away from it have not been infrequent, the sunflower that became a hay-fever ragweed being one of the innovators.

Grasses and oaks have long lived in positions favorable to a change from the ancestral plan of pollen transport by insects, but the evidence indicates that their exposure to wind was not the cause of their departure from accepted custom. This may well have been due to the advantage of having the first chance at power and raw materials, thus placing more food at their disposal.

The consequence was to put emphasis upon the two parts, stamens and pistil, which are essential to seed production; less concern was taken for the corolla and this began slowly to disappear, the calyx following at a distance.

Not a few plants, like the maples, are in the midst of this transformation today, and many still exhibit remnants of the once-useful corolla or calyx.

Some, like the four-o'clock, flowering dogwood, and poinsettia, have pressed too rapidly along the path of progress, it seems, and have had to retrace their steps, calling in some other part, such as calyx or leaf, to act as substitute for the corolla.

The final result was that all grasses came to be pollinated by the wind and now seem to show no relationship whatever to their remote forebears, the lilies.

The oaks underwent similar changes from the pattern of the ancestral witch hazels and sumacs, but carried them to the further point of assigning stamens and pistils to different flowers.

AN AGE OF SPECIALIZATION

There is considerable evidence that flowers are slowly changing today in the direction of further specialization. Much of this is due to the continuation of the processes just described, but some of it is to be assigned to the manifold disturbances wrought by man.

Apart from the breaking by plow that has destroyed most of the prairie, these disturbances include the alterations in cover and conditions due to grazing, and even more significant is the aftermath of change in abandoned fields and cutover woodlands.

In spite of destruction and modification, there still remain many thousand square miles of fairly typical prairie, especially in the farther Middle West, and this may be much increased as the numerous projects for conservation are carried into effect.

No important species of the prairie has vanished and few indeed of the rare ones, so that the local disappearance of favorites may be readily compensated for by planting in wild gardens, parks, reserves, and along highways.

The guideposts for an excursion into Nature are placed here and there in the pages that follow.

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LARKSPUR SPIKES ARE HORNS OF PLENTY FOR HONEYBEES

In payment for stolen sweets, bees pick up pollen grains on their furry bodies and carry them to other flowers, thus fertilizing the seeds. Wild flowers of the broad region from the Rocky Mountains to the Appalachians and from Canada to the Gulf of Mexico are presented in these water colors by Edith S. Clements. (1) **Tall Larkspur,** *Delphinium exaltatum;* (2) **Marsh Marigold,** *Caltha palustris;* (3) **Red Columbine,** *Aquilegia canadensis;* (4) early-blooming **Hepatica,** *Hepatica americana;* (5) **Anemone,** *Anemone caroliniana;* and (6) **Rue Anemone,** *Syndesmon thalictroides.*

BUTTERCUP FAMILY
(*Ranunculaceae*)

Persons who think of buttercups as saucer-shaped blossoms flecking spring meadows with gold may be surprised to learn that purple monkshoods, red columbines, and blue larkspurs are members of the same family.

In all flowers which are considered as belonging to the buttercup family, the badge of membership lies in the simple pistils and the many clustered stamens. They may easily be seen in the centers of globeflowers, buttercups, pulsatillas, and the like, but are hidden from view within such oddly shaped blossoms as those of monkshoods and larkspurs.

The earliest-known buttercups were found in Europe, but their descendants are scattered today over the face of the globe where cool temperatures prevail.

Tall Larkspur

Pa. to N. C.; west to Ala. and Kan.

Larkspurs (1) look not at all like their cup-shaped forebears, but appear almost fantastic, with one sepal prolonged into a spurlike slender tube, and the petals so changed as to be easily overlooked. Two have been reduced to a pair of tiny fringes which hang down over the stamens and protect them from wetting by rain or dew, while the second pair extends back into the spur in the form of two small sacks filled with honey.

It is difficult for a clumsy bumblebee to reach the store of sweets, and he makes a big fuss about it, buzzing and grumbling as he tumbles awkwardly over the stamens which block the way. Successful at last, he blunders away to rob the next flower, carrying on the underside of his hairy body ripe pollen grains which are in turn deposited on the receptive stigmas of the pistils in older flowers.

Larkspurs of the Middle West are lovers of the open prairies, the species illustrated (1) being the only one to prefer woodlands; there the long spikes of lavender-blue flowers bloom throughout July and August. Some of the prairie species are poisonous, but since stock eat them only when feed is scarce, the intelligent cattleman protects his herds by taking care not to let them overgraze the range.

Marsh Marigold

Newfoundland to S. C.; west to Sask. and Neb.

April finds the golden cups of marsh marigolds (2) opening in the pale spring sunshine and offering nectar to the yellow hover flies that find this special brand of honey very much to their liking. The plants have been used at times as potherbs in early spring when the shoots are tender, but unless well cooked they have an unpleasantly acrid flavor. The buds have been considered in some places a satisfactory substitute for French capers.

Marigolds take readily to cultivation and bloom in the garden year after year, with occasionally a second crop of blossoms in the fall.

Red Columbine

Nova Scotia to n. w. Canada; south to Fla. and Tex.

Columbines may be small and demure as the doves (*columba*) they are fancied to resemble, or large and flaunting. Their spurs may be so long that visiting insects can reach the nectar in their tips only by biting holes and stealing it, or so short they are scarcely spurs at all.

America is fortunate in having some form of this lovely flower native to nearly every State in the Union. The red columbine (3) of the East and Middle West brightens rocky woodlands with spots of vivid scarlet. On the Pacific coast similar forms show a preference for more open thickets and woods. In Colorado, the blue columbine casts a veil of delicate blue and white over mountain meadows.

Hepatica

Nova Scotia to Fla.; west to Mo., Iowa, and Manitoba

Among the earliest of flowers, hepaticas (4), which are commonly called "liverleaf," sometimes come into bloom in December in the warmer parts of the country; and March or April in middle-western and eastern woodlands finds the pale blossoms opening. Hues of delicate lavender or pink may tint the narrow petal-like sepals, which vary from six to twice that number in different flowers.

In daylight, hepatica flowers stand more or less erect and expose the pollen-laden anthers in their centers to the visits of insects; but at night, when dews might damage the pollen, they droop so that the flower resembles a half-opened bud.

Anemone

Wisconsin to Ga.; west to Tex. and S. D.

The beautiful fragile anemones (5) are called "windflowers" because they love to dwell on wind-swept prairies and hill slopes. The sepals curve inward over the stamens at night or when wet weather threatens, and there is a legend that the buds open only when the breezes blow.

Garden anemones are easily grown, and the most popular are varieties of the poppy-flowered anemone, which produces blooms as large as two and one-half inches across.

Rue Anemone

N. H. to Fla.; west to Kan. and Minn.

The rue anemone (6) presents a happy combination of beautiful foliage, like that of the rue and the dainty flowers of the anemone. The scientific name as well as the common one refers to this union, for *Syndesmon* means "bound together." The blossoms are white or pale pink and bloom very early in the woodlands of the East and Middle West. If transferred to the garden, the plants should be placed in partial shade.

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BLOODROOT AND DUTCHMAN'S-BREECHES ARE DESCRIBED BY THEIR NAMES

A representative of the Poppy clan is the (1) **Bloodroot,** *Sanguinaria canadensis,* whose pure white flower stems from a red-brown root. Close relatives of the Poppies are the dainty (2) **Dutchman's-Breeches,** *Dicentra cucullaria,* suggesting a Netherlander's trousers, and the sun-loving (3) **Golden Corydalis,** *Corydalis aurea.* (4) **Pink Cleome,** *Cleome serrulata,* belonging to the Caper family, is cultivated on a large scale as a source of honey. A fragrant member of the Mustard group is the glowing (5) **Western Wallflower,** *Erysimum asperum.*

POPPY FAMILY
(*Papaveraceae*)

The petals of poppies gathered from field or garden fall so quickly that the flowers must be enjoyed where they grow rather than be fashioned into bouquets. Moreover, many of the cut stems exude a milky juice which is disagreeably sticky to the touch, or merely watery and acrid. Although the flower lover may view this characteristic with disfavor, not so dealers in opium and other drugs derived from it.

Closely related to the poppies is the group of plants called "fumitories" because of a faint odor of smoke in the foliage of some species. The best known are probably Dutchman's-breeches, which look very little like poppies.

Bloodroot

Nova Scotia to Fla.; west to Ark., Kan., N. D., Manitoba

This creamy-white blossom (1) might be mistaken at first glance for an anemone, but since the petals are deciduous and the pod is one-celled and two-valved, it actually resembles poppies more than buttercups.

The leaves continue to grow after the petals have fallen, becoming so large by the middle of the summer as to give the plants an entirely different appearance.

It is the red-brown root with bright-red flesh and juice which gives the clue to identity as well as the name of "bloodroot" to the plant. All parts when cut or broken exude this red juice, which is acrid and bitter to the taste and possesses narcotic and stimulant properties.

Bloodroots, among the earliest flowers, grow abundantly in the loose, rich soil of woodlands.

Dutchman's-Breeches

Nova Scotia to N. C.; west to Minn., Mo., Kan.

The coolness of shadows suits this daintiest of spring plants so well that it must be sought beneath the overhanging branches of woodland bushes. Here, from clusters of feathery gray-green foliage, spring slender, curving stalks on which are hung the oddly shaped white or pale-pink blossoms named from a fanciful resemblance to baggy Dutch trousers (2).

The bruised foliage of the related fumitory gives off a faint odor as of smoke, and Pliny noted that it also causes the eyes to smart.

Golden Corydalis

Nova Scotia to Minn. and Alaska; south to Pa., Mo., Calif.

Golden corydalis (3) closely resembles the dicentras in the structure of the flower and in the similarly finely cut foliage. It prefers open spaces where gravelly soils may be covered by the masses of silvery-green leaves and clusters of bright-yellow blossoms. In dry seasons the plants may be dwarfed to but an inch or so in height, but when moisture is plentiful they may grow a foot tall and cover an area two feet in diameter.

The flowers have but one spur and are jauntily crested and erect. This is taken note of in the scientific name, meaning "crested lark."

CAPER FAMILY
(*Capparidaceae*)

The capers may well be regarded as direct ancestors of the mustards, from which they may be distinguished by numerous projecting stamens with threadlike filaments and by pods borne on long, slender stalks. The petals are narrowed at the base like those of a mustard blossom, but spread widely instead of forming a compact group. The family is not a large one; its best-known member is French capers, a shrub from the Mediterranean region with pungent buds that have been used in medicine since ancient times.

Pink Cleome

Ill. to Minn. and w. Canada; south to Mo., N. M., Ariz.

The ball-like clusters of pink cleome flowers (4) are at their loveliest midway in their blooming period. Then many individual blossoms are wide open, with the long rose-colored filaments of the stamens uncurled and spread widely, each tipped with a bright-green anther, while next above these are half-opened flowers of a deeper hue, and the cluster is rounded off at the top with dark rose-purple buds.

Bees are attracted in such great numbers to the nectar secreted abundantly by these dainty blossoms of prairie and roadside that the species is often called "Rocky Mountain bee plant" and has been cultivated for many years as a source of commercial honey.

MUSTARD FAMILY
(*Brassicaceae*)

Members of the mustard family are to be recognized by the four petals of the flower arranged in pairs at right angles to each other in the form of a Maltese cross, and the seed pod with a partition down the middle. The number of stamens may be either four or six. If six, two are shorter than the others.

More useful if less beautiful members of the family yield vegetables such as cabbages, Brussels sprouts, turnips, cauliflower, and radishes, all of which will produce flowers of similar structure if allowed to "go to seed."

Western Wallflower

Manitoba to Okla.; west to N. M. and Montana

The fragrant globelike clusters of the western wallflower (5) may wear any tint of yellow from pale cream-color through lemon and gold to burnt orange of so deep a shade as to seem almost brown. It is a ready traveler, but prefers to take root in sandy fields instead of among the fallen stones of ruined walls, where a distant cousin, the true wallflower, flourishes after escaping from English gardens. Other relatives are the wild radish, which clothes vacant fields in California with masses of rose-purple blossoms, and the charlock, which annoys eastern farmers.

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LOVELY TO LOOK AT, SNOW-ON-THE-MOUNTAIN (1) CARRIES POISON IN ITS VEINS

The milky juice of the striking *Euphorbia marginata,* a member of the Spurge family, may blister the picker's skin. Related to hibiscus, hollyhock, cotton, and okra are the rosy (2) **Poppy Mallow,** *Callirhoe involucrata;* (3) **High Mallow,** *Malva sylvestris,* with notched petals; and (4) **Flower-of-an-Hour,** *Hibiscus trionum,* which opens its blossoms only for a short period each day. Other Mallows are (5) **Red False-Mallow,** *Malvastrum coccineum,* which paints the prairies in late spring, and (6) **Velvet Leaf,** *Abutilon theophrasti,* an immigrant from India.

SPURGE FAMILY
(*Euphorbiaceae*)

Although the Greek words "beautiful herb," applied to the spurges, may describe such as have ornamental foliage, the great majority are insignificant plants with no charm whatever. Many are desert dwellers, or grow in dry and sterile places, and are frequently so bizarre in appearance as to be cultivated as curiosities, often together with the even more fantastic cacti.

Whatever color or beauty the spurges have resides in the ornamental bracts which surround the group of tiny stamens and pistils which form the flower proper.

Spurges are also characterized by a milky juice in leaves and stems, which, although frequently poisonous in varying degrees, is the source of valuable articles of commerce, such as drugs and dyes. Castor oil and rubber are other products from members of the family.

Snow-on-the-Mountain

Minn. to Colo.; south to Tex.

When massed in gardens or beside the road, snow-on-the-mountain plants (1) give strikingly handsome effects, especially when the snowy-white edgings to the smooth gray-green leaves and bracts are unusually well marked.

It is well, however, to "touch not, taste not," for the milky juice which exudes from cut stems may blister the skin, and honey from the flowers causes unpleasant effects when eaten.

Many euphorbias are insignificant herbs, but the poinsettia (*E. pulcherrima*) has few rivals for stately beauty. The plants may grow to the height of small trees.

MALLOW FAMILY
(*Malvaceae*)

Many mallow flowers are brightly colored and beautiful, the hibiscus, hollyhock, and abutilon deserving special mention. The cotton blossom is attractive in itself, but has been cultivated since earliest times for the sake of the fibers produced by the seed coats. Okra, marshmallow, drugs, and drinks are also supplied by different members of this family.

Poppy Mallow

Minn. to Mo.; west to Tex., Utah, Wyo.

Callirhoe (Callirrhoë), the musical Greek name of the poppy mallow (2), is the same as that borne by a nymph of the sea, perhaps because both are beautiful, for there seems to be no other point of resemblance between a wild flower of the Middle West and the South and a mythical maid of the ocean.

Brilliantly colored, this mallow occurs in patches of crimson purple or cherry red all summer long on prairies and plains from Minnesota to Texas, in company with a species of paler tint (*C. alceoides*) and the poppy mallow with large reddish-purple flowers with fringed petals (*C. digitata*).

High Mallow

Occasional escape from cultivation

Malva is the genus which has given the scientific name to the mallow family, and is represented by a number of common species which have come over from the Old World and run wild in this free country. Among these are the "cheeses," which conceal tiny flowers of pale hue by numerous large round leaves, but which on maturing produce mucilaginous fruits sought by children at play. Others are the musk mallow, with large rose-colored or white flowers, and the high mallow (3), which grows in waysides and about gardens.

On the Pacific coast the mission mallow has long been a favorite of the Franciscan fathers from whose gardens it has escaped, and the stately shrubs with maplelike evergreen leaves and rose-purple blossoms may now be found where the ocean spray keeps cool the air.

Flower-of-an-Hour

Nova Scotia to Fla.; west to S. D. and Kan.

The dainty little flower-of-an-hour (4), though it works on "short shift," clothes waysides, roadsides, ditches, and waste places during hot summer days with a low mass of fresh green leaves and cream-colored blossoms. The tiny fruits are like fairy lanterns decorated with pale-green flutings and dark veins.

Eastern marshes are the homes of the swamp rose mallow (*H. moscheutos*) whose large pink flowers, sometimes seven inches across, are of unrivaled loveliness, although the crimson-eye rose mallow (*H. oculiroseus*), in similar situations, is a close rival.

Red False-Mallow

Manitoba to Iowa; west to Tex., Utah, Ore.

May on midwestern prairies and plains sees the earliest blossoms of this malvastrum (5), and by midsummer they may cover large areas with vermilion-red masses of color, the grayish green of the foliage making a happy combination with the bright hue of the flowers. A very similar western cousin (*M. ambiguum*) blooms so abundantly in overgrazed cattle country as to cast a rust-colored haze over the landscape as far as one can see. Quite different in coloring and habit, the delicate rose-lavender blossoms of the bush mallow (*M. fasciculatum*) grace shrubs of southern California hills.

Velvet Leaf

Eastern, Central, and Southern States

The soft velvety leaves of this abutilon (6), which has come to our country from faraway India, are much more conspicuous than the small, dull-yellow blossoms on short stalks beneath them. Although classed as a weed, since it is quite content to occupy waste places, vacant lots, and similar spots throughout warm countries, it helps redeem them from barren ugliness and is by no means a nuisance to the farmer. It is grateful for any care and will add its share to the garden.

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BLUE POOLS OF FLAX RIPPLE IN THE PRAIRIE BREEZE

Western Indians spin cord from the fibers of (1) **Blue Flax,** *Linum lewisii,* a wild branch of the Flax clan, source of linen. Of the numerous Violets, the (2) **Two-Color,** *Viola pedata bicolor,* and the large (3) **Birdsfoot,** *Viola pedata,* are shown. The ripe fruit of the (4) **Violet Woodsorrel,** *Oxalis violacea,* bursts at a touch, scattering wide its seeds. (5) **Wild Geranium,** *Geranium maculatum.* (6) **Jewelweed,** *Impatiens biflora,* belongs to the Touch-Me-Nots.

Blue Flax

Manitoba to Neb.; west to Tex., Calif., and Alaska

A field sown thickly with seeds of the cultivated flax will become a sea of azure-blue blossoms rippling in the breeze, while the wild blue flax may form pools of color here and there on the prairies. The same brief span of life governs both, and after 10 o'clock on a sunny day, both "sea" and "pool" have given way to a dull expanse of gray green.

The flowers of the wild blue flax (1) are somewhat larger than those of the cultivated variety, and, although the fibers in the stems are not so long and strong, from them the Indians of the Northwest have woven baskets, mats, snowshoes, fish nets, and similar useful articles.

VIOLET FAMILY

(*Violaceae*)

The violet family seems to be more or less a homeless waif among flower families, for, although several claim close relationship, the evidence on which the claims are based is either contradictory or inconclusive.

There is scarcely a part of the country where violets are not to be found, unless it be the deserts. Some prefer swamps and bogs, moist ravines, thickets or woods; others like dry prairies, hillsides, mountains, and subarctic regions, or waste places and cultivated fields.

Birdsfoot Violet

Mass. to Minn.; south to Fla. and La.

One of the largest and showiest of violets is this species (3) with leaves so deeply cut as to suggest the name "birdsfoot." The spring months find it blooming in open woods.

Two-Color Violet

Mass. to Minn.; south to Fla. and La.

Two shades of color distinguish this variety (2) of the birdsfoot violet (3). Frequently there are streaks, dots, or splotches of darker shades on a lighter background, and all variations may be present in the flowers of one plant.

In flower economy, these markings usually serve the purpose of guiding pollinating insects to the nectar, but although violets have some honey in the spur, they receive few visitors. In consequence, many of the species have perfected a unique method of self-pollination.

Toward the end of the flowering period, the buds fail to open, and within them the pollen is transferred from anther to stigma by direct contact. As the fruit matures, it splits into three little canoe-shaped sections, each filled with a row of shining brown seeds, which are shot far out as the drying sections contract.

It is this brisk popping about, among autumn leaves, of objects which resemble fleas in size and color, that has led countryfolk in England to the belief that "violets breed fleas."

OXALIS FAMILY

(*Oxalidaceae*)

The woodsorrels may be recognized by leaves made up of three leaflets which fold together and "go to sleep" at night or in cool weather; by their pleasant acid taste; and by regular five-parted flowers. They show so close a relationship to the geraniums in the flower structure that the two families are often considered as one. The differences lie in the fact that the woodsorrels have but five stamens and many seeds in the capsule, while the geraniums possess ten stamens in sets of five each and a five-seeded pod with a beak.

Both have perfected devices for scattering the seeds, the geranium by means of a sort of slingshot for each seed, while the ripe fruit of the woodsorrels bursts at a touch and the seeds pop out in all directions.

Violet Woodsorrel

Mass. to S. D.; south to Fla. and Tex.

The violet woodsorrel (4) is a delicate flower of open woods in the East and Middle West. The commonest woodsorrels are insignificant plants with small white or yellow flowers (*O. corniculata*) which bloom all summer on lawns or roadside without becoming pests.

GERANIUM FAMILY

(*Geraniaceae*)

The best-known member of the geranium family is the garden nasturtium. Wild geraniums are better known by the common names of "storksbill," "cranesbill," and the like, from the resemblance of the tapering seed pods to the slender beaks of birds.

Wild Geranium

Maine to Manitoba; south to Ga., Ala., Neb.

Open woods throughout the East and Middle West shelter this rose, blue, or lavender species (5), and a western cousin (*G. incisum*) decorates the margins of mountain forests with rose purple.

The ten stamens of a geranium flower are arranged in two sets of five of slightly different lengths. The longer ones mature first and shed their pollen, then the shorter ones, and when all the pollen has been dropped or taken away by insect visitors, which seek the nectar at the base of each petal, the five slender stigmas curl outward and are ready to receive pollen.

TOUCH-ME-NOT FAMILY

(*Balsaminaceae*)

The family name is based on the fact that the mature capsule bursts apart at the merest touch and scatters the seeds far and wide.

Jewelweed

Newfoundland to Sask.; south to Fla. and Neb.

The name "jewelweed" may have been given this balsam (6) because its orange-yellow blossoms hang like pendants and form spots of glowing color in the shadows of moist woods.

PINK FAMILY
(*Dianthaceae*)

Flower families are designated as a rule by the name of an important genus which may be changed from time to time at the dictate of the taxonomer. Thus it happens that when the carnation was called Caryophyllus, the family name was Caryophyllaceae. Later it became Dianthus and the family name changed accordingly to Dianthaceae, which counts among its members the clove pinks or carnations, Indian pinks, and other attractive garden or florists' plants. There are also annoying weeds, such as the corn cockle, with poisonous seeds, some species used in medicine, and many with insignificant blossoms, like the chickweeds, but with seeds that house canaries relish.

Bouncing Bet
Eastern and Central States

It is a simple matter for plant immigrants from Europe to become stowaways by means of seeds attached to cargoes of merchandise of all sorts. Once within this country, these foreigners speedily settle down and colonize waste places everywhere. They are sturdy and aggressive and quick to seize opportunities denied them in the Old Country, where crowded human populations must utilize every foot of productive soil.

Bouncing Bet (1) is one of the less obnoxious invaders, with flowers sufficiently ornamental to make its presence along roadsides not unwelcome. These are rose pink, paling to white, in large, loose clusters at the ends of rather stiff leafy stems. The plants are robust and spread with an energy that may well have been the basis for their name. The roots are supplied with a sap that lathers when mixed with water and suggests the Latin name for the genus, the root of which means "soap," as well as the common name of "soapwort."

Fire Pink
N. J. to Ont. and Minn.; south to Ga. and Mo.

The glowing vermilion blossoms of the fire pink (2) are found in dry woods from May to September throughout the Middle West. The stems are covered with a sticky substance that is disagreeable to the touch, but seems to serve the purpose, in plant economy, of entangling the wings of small insects on their way to steal the honey from the flower or to plunder the seeds. Sometimes these tiny marauders, unaided, are held prisoners for life.

PURSLANE FAMILY
(*Portulacaceae*)

Many purslanes make little or no claim to beauty, since the flowers are tiny and short-lived, but their thick and juicy leaves are of value in salads, or furnish mild tonics. One, which has beautiful blossoms as well as edible herbage, is red maids of grassy meadows on the Pacific coast. The Indians of early California made use of these plants as greens and ate the roasted seeds also. The flowers remain open only a few hours, but during this period offer a glimpse of brilliant rose-purple, satiny petals. Probably the most beautiful of native purslanes, the bitterroot of the Northwest, has large flowers with many narrow pink or white petals. The large roots are extremely bitter when raw, but the Indians have found them nourishing and tasty when well cooked.

Tiny Talinum
Minn., S. D., and Ark.; west to Ariz. and Tex.

The few species of talinum (3) to be found here and there in rocky or dry soil are all much alike in having succulent foliage and pinkish flowers on threadlike stems. The size of the blossoms varies somewhat in the different kinds, but since they close after a short period of blooming, they may easily be overlooked.

Spring Beauty
Nova Scotia to Sask.; south to Ga., Tex., Mont.

The delicate charm of the spring beauties (4) offers a distinct contrast to the gorgeous coloring of their South American cousin, the rose moss of our gardens, for their pale-pink flowers are dainty in form and color, and they bloom unobtrusively in moist woods instead of flaunting their faces boldly where all may see. The fragile blossoms live only a few days during the coolness of early spring and by the end of May can be found no longer.

BUCKWHEAT FAMILY
(*Polygonaceae*)

The buckwheats are more distinguished as the source of food and drugs than for beauty. The first prize should perhaps be awarded to the plant whose three-cornered seeds, so like tiny beechnuts, are packed with a starch of the distinctive taste which makes buckwheat flour so well liked in griddlecakes. Moreover, the flowers of this buckwheat yield a fine honey that may well be spread on those same cakes.

The homely docks and sorrels deserve honorable mention as the source of an acid with more or less value as a drug, while that contained in the rhubarbs adds a special flavor, in the spring, to the sauces and pies made from the petioles of the leaves.

Heartsease
Nova Scotia to Fla.; west to Kan. and Minn.

The roots of many species of polygonum possess acrid juices which are useful as astringents and which also give the reason for the name of "smartweed" often used for the plants (5). The scientific name of the genus, as well as the popular one of "knotweed," refers to the knobby swellings at the joints of the stems. As a rule, the plants are weedy in habit, with spikes of rose-pink flowers which may clothe moist roadside ditches all summer.

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IMMIGRANT BOUNCING BET (1) THRIVES ON ROADSIDES AND WASTE LAND

From Europe comes *Saponaria officinalis*, a Pink with clusters of pale-rose flowers. (2) **Fire Pink,** *Silene virginica*, has petals like red tongues. (3) **Tiny Talinum,** *Talinum parviflorum*, one of the Purslanes, is used in salads. Shy (4) **Spring Beauty,** *Claytonia virginica*, hides in cool woods. *Polygonum pensylvanicum* is the correct Latin name for (5) **Heartsease,** a decorative Buckwheat. In the old days, when this species was named, "Pennsylvania" was commonly spelled with only two n's.

PRIMROSE FAMILY

(*Primulaceae*)

There is, of course, nothing of the "rose" in any member of the primrose family except the name, which is said to be a corruption of an old French word, *primerole*. The Latin *primula* is descriptive in that it means "first flower of spring," for although many bloom in the summer time, cool seasons or cool climates are the preference of most.

Attractive in appearance, primroses disdain to be useful, as are their next of kin, the buckwheats and purslanes, although primrose wine may be made from the flowers of some species and certain bitter drugs come from others.

Birdseye Primrose

Newfoundland and Labrador to Mich.

The birdseye primrose (1), after the snows have gone, blooms throughout eastern Canada and northern Maine, with a decided preference for the northern shores of the Great Lakes. The clusters of flowers, each with a yellow center like a bird's eye, are borne on slender stems; the underside of the young leaves is so covered with a white mealiness as to give the species the scientific name of *farinosa*.

Shooting Star

Pa. to Ga.; west to Tex., S. D., Manitoba

In these charming blossoms the slender stamens are grouped closely together to form a sharp point from which five ribbonlike petals flare backward like the tail of a comet (2). These earthly stars prefer rose to yellow and vary in tint from white to brilliant magenta or rose purple. They may be found in moist places throughout the country.

Loosestrife

Maine to Fla.; west to N. D., La., and Ariz.

The saucer-shaped blossoms of this member of the primrose family (3) are of an exquisitely pale-yellow tint, and though there is no great mass of bloom, since the flowers occur in pairs in the axils of the leaves, they are individually charming. All five of our native species are yellow-flowered and are to be found in moist thickets or swampy ground.

GENTIAN FAMILY

(*Gentianaceae*)

The family takes its name from King Gentius, who ruled over Illyria some 2,000 years ago. The story goes that he made such good use of the bitter tonic in some of these plants as to check the ravages of malarial fever in his army.

Rose Gentian

Iowa to Ark.; west to Kan. and Tex.

Midsummer sees the prairies abloom with nothing more vivid in hue than the rose gentian (4), which forms patches of glowing color here, there, and everywhere. The shallow disks of vivid rose are different enough from the namesake of King Gentius to be placed in another genus and named in honor of Sabati, an Italian botanist who lived in the 18th century.

A rose gentian (*S. angularis*) with four-angled stems and smaller flowers of the same brilliant color, grows in rich soil in the East and South, and western mountains offer choice sites for Amarella (*Gentiana amarella*) with tiny lavender blossoms fringed at the throat.

Fringed Gentian

Quebec to Manitoba; south to Iowa and Ga.

It is the blue gentians (5) that claim the stellar role in the floral pageantry of autumn. From the blue of this fringed gentian, which artists assert most nearly approaches that of the sky, to the dark purple blue of the fringed gentian (*G. calycosa*) in the Sierra Nevada and Cascade Range, some variation in tint or shade is claimed by nearly every one of the true gentians. They are all deep-throated flowers, with petals joined into a tube and often cut around the edges or at the joinings into fringes of varying length and thickness.

DOGBANE FAMILY

(*Apocynaceae*)

A red flag of warning should be waved by practically every member of this criminal family, for, concealed by attractive exteriors, handsome foliage, beautiful and sweet-scented flowers, lurks the potential poisoner.

Although the greater number of plants in this family inhabit the tropical zones and so do not immediately concern us, some, like the oleander, have been transferred to our gardens and a few may be found growing wild. They are so attractive and yet so poisonous that everyone should learn to know them by sight in order to avoid risks due to ignorance of their true nature. To chew an oleander leaf or twig may be fatal!

Pink Dogbane

Quebec to Ga.; west to Ariz., Idaho, and B. C.

This attractive little plant (6), with its descriptive common name and appallingly long scientific one, forms low borders to thickets in the East and West and is especially abundant along the Missouri River. In British Columbia many hundreds of acres may be given over to it.

Bees, attracted by the sweet odor, hover about it continually in search of the excellent honey concealed in the tiny blossoms.

It is only the larger bees that are able to visit the flowers with impunity, for an ingenious trap formed by the growing together of the anthers catches smaller insects that are unable to bring about pollination and yet would like to have a share of the nectar. Besides yielding honey of commercial value, the pink dogbane serves mankind with a medicinal drug obtained from the roots, and recently the milky juice of the stems has been found to contain a rather high percentage of rubber.

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"PRIMROSES, THE SPRING MAY LOVE THEM; SUMMER KNOWS BUT LITTLE OF THEM"

Thus William Wordsworth described the early-blooming family of which three representatives are shown: (1) **Birdseye Primrose,** *Primula farinosa,* which prefers lake shores of the northern Middle West; (2) **Shooting Star,** *Dodecatheon meadia;* and twin-blossomed (3) **Loosestrife,** *Steironema lanceolatum.* Blushing (4) **Rose Gentian,** *Sabatia campestris,* contrasts with the blue goblets of (5) **Fringed Gentian,** *Gentiana crinita.* One of the less virulent members of a poisonous family is (6) **Pink Dogbane,** *Apocynum androsaemifolium.*

POTATO FAMILY

(*Solanaceae*)

The family to which the humble potato belongs yields mankind other garden vegetables such as tomatoes and eggplants, the valuable drugs of belladonna, atropine, and nicotine, and such favorite flowers as petunia, butterfly flower, and Chinese lantern.

Since the family comprises some species with violent poisons, such as the deadly nightshade and Jimson weed, suspicion has at times rested upon members which were later proved innocent. For a long time tomatoes were considered unpalatable and even today are regarded with suspicion in certain parts of the world. The tubers of the potato may be actually poisonous if eaten when young.

Silver Nightshade

Mo. to Tex.; west to Calif.

Waste places may often be redeemed from ugliness by the silvered foliage and attractive rose-lavender blossoms of the silver nightshade (1). The flowers are distinctive in being quite flat, five-pointed, and crinkled or ruffled where the petals join.

Many solanums are poisonous, in part at least, or at some time during their development. Thus the unripe berries of the black nightshade, which has small white flowers, may be extremely poisonous, but can be safely used in pies and preserves when thoroughly ripe and well cooked. On the other hand, the bright orange-colored berries of the bittersweet (*S. dulcamara*) are poisonous at all times.

Purple Ground-Cherry

Kan. to Tex.; west to Ariz.

Unlike many of the ground-cherries which have drooping, bell-shaped flowers, such as the clammy ground-cherry (*P. heterophylla*) of the eastern half of the country, those of the purple ground-cherry (2) of high plains resemble nightshade blossoms in being flat and saucerlike, with plaited borders. They are borne on low, spreading plants with abundant leaves.

In some varieties the fruits have a delicious flavor and form an important article of trade in the West Indies, in Mexico, and other Latin American countries. Each berry is enclosed in an inflated calyx of papery texture and often of such brilliant coloring as to be unusually ornamental, such as that of the Chinese lantern of our gardens, which is two inches in diameter and a glowing red in color.

BORAGE FAMILY

(*Boraginaceae*)

In days gone by, the borage family enjoyed great repute as supplying more herbs to professional and domestic medicine than almost any other flower family. Today not one of them is considered of any value in treating human ailments. Even a layman nowadays would scoff at the idea of using the lungwort (*Mertensia*) in lung diseases simply because the leaves were mottled. Nor would he rely on viper's bugloss (*Echium vulgare*) for snakebite because its flower cluster coils snakelike as it matures, nor on the puccoon (*Lithospermum*) for dissolving bladder stones because its seeds resemble small round stones.

Although with the passing of the years and the advance of knowledge, the family may have lost its prestige in the field of medicine, it still boasts a large number of plants of unusual beauty and charm. Here belong the fragrant forget-me-not, heliotrope, hound's-tongue, fiddle-neck, and many other garden favorites or familiar wild flowers.

Stickseed

Manitoba to N. M.; west to Calif. and B. C.

In autumn, when the tiny, burlike fruits of the stickseeds (3) attach themselves by the score to the clothing of anyone intent on a stroll through fields or woodlands, it is easy to forget that early in the season clusters of forget-me-not-blue flowers bloomed in their place. That these little hooked fruits may be more impressive than the blossoms is attested by the names "stickseed" and "Lappula," the latter word meaning "little bur." However, the flowers of the species illustrated are so like those of the true forget-me-not that its sins are more easily forgiven than are those of the many other species which occur as weeds the country over and have flowers so small and lacking in bright color as to be entirely without charm.

Virginia Bluebell

N. Y. to Ga.; west to Minn. and Kan.

The pale-blue flowers and rosy-pink buds of the Virginia bluebells (4) are clustered on slender branches which arch gracefully over rushing brooks or smooth-flowing streams. They are past blooming by the end of May, but high up in the Rockies of Colorado, the Sierra Nevada of California, and far northward, the mountain mertensia (*M. sibirica*) remains in flower until midsummer. At still higher altitudes and above timberline, the alpine mertensia (*M. alpina*) perfumes the air with sweet-scented blossoms of a deeper blue.

Fringed Puccoon

Manitoba to Ill.; west to Tex., Ariz., and B. C.

The prairies are at the height of their floral beauty from April to July when the puccoons appear to add a touch of yellow in long-tubed blossoms with crinkled edges to the petals (5). When the seeds are formed late in the season, they are seen to be tiny, hard, and round like pearls or white stones, and for this reason the name of "pearlwort" is also sometimes used for these plants. The hairy puccoon (*L. canescens*) may dwell side by side with the fringed puccoon, its orange-hued blossoms adding a deeper note of color to the scene.

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NIGHTSHADES, MANY POISONOUS, ARE COUSINS OF POTATOES AND TOMATOES

So many members of the Potato family are harmful that innocent species, such as the tomato, were long thought guilty. Star-shaped (1) **Silver Nightshade,** *Solanum elaeagnifolium,* flourishes on waste lands. On high plains sprawls (2) **Purple Ground-Cherry,** *Physalis lobata.* (3) **Stickseed,** *Lappula floribunda,* bears clinging burlike fruits. (4) **Virginia Bluebell,** *Mertensia virginica,* has pink buds; and (5) **Fringed Puccoon,** *Lithospermum linearifolium,* cheerful yellow "trumpets."

MORNING-GLORY FAMILY

(*Convolvulaceae*)

Morning-glory vines clamber over trellises or fences in our gardens and open trumpet-shaped blossoms of varied hues during the early hours of the day, giving pleasure to all; bindweeds of many sorts cover the ground with close mats of arrow-shaped leaves and creeping stems which cause the farmer great vexation and much extra labor, for they are exceedingly difficult to eradicate.

Sweet-potato vines likewise spread over the ground and bear blossoms similar to those of the morning-glory, but they are welcomed since their edible tubers are filled with a sweet starch. Quite different in appearance to all these, but also belonging to the same family, the dodder smothers low shrubs with masses of bright-orange twining stems which look like skeins of tangled silken threads.

Small Bindweed

Throughout United States

This little immigrant, although attractive to look at in full bloom (1), is one of the worst of pests in field or garden. Once established, it is almost impossible to eradicate and soon ruins the land for crops. It also climbs over useful or ornamental plants, handicapping them in the struggle for existence or even killing them off entirely. The flowers are daintily pink and white, and, though smaller, very similar to those of the hedge bindweed (*C. sepium*), which is even more successful in eliminating competitors.

SNAPDRAGON FAMILY

(*Scrophulariaceae*)

The majority of flower families are made up of flowers that are symmetrical in shape and have a definite number plan for sepals, petals, stamens, and parts of the ovary. Often there may be found irregular forms, such as the larkspurs and monkshoods among the buttercups, and in some families it is the oddly shaped flowers that become the rule and regular ones the exception.

Such a family is that to which the snapdragons, pentstemons, wood betonies, foxgloves, and blossoms of similar appearance and structure belong. It is an unusually large and beautiful family of attractive wild flowers and garden ornamentals, with but one of any value medicinally, the foxglove, which yields digitalis used in diseases of the heart.

Giant Pentstemon

Wis. to Mo.; west to Okla., Colo., Wyo.

Bumblebees find the broad lower lip of a pentstemon flower a very convenient place on which to alight as they make their daily rounds in search of nectar and pollen. It is a simple matter then to enter the open throat of the blossom and, though the fuzzy sterile stamen which lies at the entrance may cause some grumbling at the obstruction, it serves the purpose of forcing the visitor's back up against the ripe pollen clinging to the anthers.

Flowers as large as those of the giant pentstemon (2), which are nearly two inches in length, or those of the cobaea pentstemon (*P. cobaea*) of similar size, offer easy access even to the largest bees; but in the tiny flowers of the clustered pentstemon (*P. confertus*) or the narrow tubes of the scarlet bugler (*P. centranthifolius*) honey is accessible only to the smaller bees and insects. Within these limits there are all variations in size, and all shades of blue, purple, pink, scarlet, or lavender are to be found within this genus, yellow being the only color unrepresented.

Sand Pentstemon

Colo. to Tex.; west to Ariz. and Utah

The sand pentstemon (3) presents something of a puzzle in often having five anther-bearing stamens, and in the unusual size of the spreading lobes of the corolla in comparison with the slenderness of the tube. That is perhaps why part of the scientific name is *ambiguus!* However, it is a most charming flower, which in summer covers sandy spots on the plains with a wealth of delicate pink blossoms tinged with carmine in the throat. The buds also are this same deep hue. The plants do well when transferred to the garden in sandy soil.

Butter-and-Eggs

Newfoundland to Ga.; west to N. M. and Manitoba

When European plant immigrants are as attractive as butter-and-eggs (4) with its close clusters of two-toned yellow flowers, they are welcome invaders of bare or waste ground, and since they are not likely to spread rapidly from these chosen sites into the farmer's fields, he need only see to it that they do not gain the first foothold. Once established, however, they are difficult to eradicate.

The name of the genus, which is derived from the Latin word for "thread," refers to the similarity of the narrow leaves to those of flax. There are lovely linarias for garden culture, some with white, blue, or purple flowers, and they need little care.

Turtlehead

Newfoundland to Fla.; west to Kan. and Manitoba

The names of many flowers are often misleading, inappropriate, or harsh-sounding, but in the case of the turtlehead (5) the flattish corolla slightly protruding from the enclosing leaves has a similarity to the head of a tortoise emerging from the shell; also, like turtles, the plants are most at home in wet places.

The pink turtlehead (*C. lyoni*) of eastern swamps is similar in appearance to this one farther west, but the blossoms are a deeper rose purple. Both will do well in the garden if planted in moist soil and half-shade.

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DAINTY BLOOMS OF SMALL BINDWEED (1) SPRING FROM CROP-STRANGLING VINES

Farmers' foe is *Convolvulus arvensis,* the fast-spreading "black sheep" of the Morning-glory clan, an unwelcome colonist from Europe. Oddly shaped flowers are the rule among the Figworts. Examples are (2) **Giant Pentstemon,** *Pentstemon grandiflorus,* with lavender "bells," and (3) **Sand Pentstemon,** *Pentstemon ambiguus.* (4) **Butter-and-Eggs,** *Linaria vulgaris,* is a welcome immigrant. Compact (5) **Turtlehead,** *Chelone glabra,* favors wet places and half-shade.

Pink Gerardia

Quebec to Ga.; west to La., Kan., and Manitoba

In the 16th century the botanist John Gerard wrote a large and comprehensive volume concerning the plants known in his day, with descriptions and notes as to their uses. To a modern reader, this is one of the quaintest of books, although there is much information in it that has stood the test of time.

The author's fame has been further perpetuated in the naming after him of a genus of flowers which are occasionally yellow but more often some tint of rose purple. This pink gerardia (2) is a lovely shade of rose with a pale-yellow throat, and the slender plants with narrow leaves are found blooming in dry woods and thickets in late summer and autumn.

Yellow Wood Betony

Nova Scotia to Fla.; west to N. M., S. D., and Manitoba

The pale-yellow flower of this wood betony (3) looks comically like some tiny animal with eyes at either side of the head and a tusk protruding from the mouth. They are grouped in a roundish cluster at the end of a rather thick stiff stem, with attractive leaves of a soft grayish green very much scalloped and ruffled along the edges. The plants are most at home in dry woods or thickets of the Middle West and aspen groves in the Rocky Mountains. In the Northwest, boggy mountain meadows offer coolness and moisture to another Pedicularis (*P. ornithorhyncha*), which has similar oddly shaped blossoms of deep rose purple clustered at the ends of short stems.

PHLOX FAMILY

(*Polemoniaceae*)

The phlox family is one of those better known for its many handsome ornamentals than for practical value. Among these are bright-colored sweet williams, gilias of many hues, blue polemoniums, Jacob's-ladder, etc., some of which are to be found in almost any garden. The Pacific coast is especially rich in wild species of gilia and polemonium, and eastern woodlands shelter the dainty creeping polemonium of tender blue.

Meadow Phlox

Ontario to Fla.; west to Tex. and Manitoba

There are many native phloxes in this country which should be placed in the garden with the sweet williams, since they respond to cultivation readily and bloom profusely with little care. As early as 1720 some of the taller species were taken to England and planted in gardens, since none grow wild there.

Although the name "phlox" means "flame," these dainty blossoms exhibit many shades of blue and lavender, as well as the brighter pinks, carmines, or rose purples. Of the latter, the wild sweet william (*Phlox maculata*) grows in moist woods and along streams in the East, while the meadow phlox (1) brightens dry prairies of both the East and the Middle West with flowers of an even more vivid hue.

ACANTHUS FAMILY

(*Acanthaceae*)

There are comparatively few well-known members of the acanthus family in this country, since they seem to prefer more tropical climates, where they supply the natives with foods, dyes, and drugs. A unique use has been found for a shrubby species in East India. When planted in the rice fields, it is said to produce a poison capable of destroying aquatic weeds and low forms of injurious insect life.

A few ornamentals have been brought to this country and placed under cultivation, and a number of wild species are to be found in the warmer parts of the South and East.

Hairy Ruellia

N. J. to Fla.; west to Tex. and Neb.

Here and there on our prairies, where the soil becomes more or less dry during hot summer days, leafy plants of the hairy ruellia (4) bear slender long-tubed blossoms of pale lavender. They may be two or three inches in length, with petals spreading widely at the throat, but being short-lived and few, they make no great showing of color.

VERBENA FAMILY

(*Verbenaceae*)

From the gigantic Asiatic forest tree (*Tectona grandis*), which is the source of the handsome teakwood used by cabinetmakers and builders, to the unassuming little wild flower of the roadsides, members of the verbena family exhibit a wide range of usefulness or beauty. A few make contributions as dyes, oils, and decoctions. The Tropics furnish many of the ornamentals, such as lantanas, callicarpas, and the fragrant verbena familiar in many gardens and so similar to some of our wild species as to suggest that they, too, might well be cultivated.

Prairie Verbena

S. D. to La. and Tex.

From May to September, the rose or blue-lavender flowers of this verbena (5) make patches of bright color throughout dry plains and prairies of the Middle West, and one with larger blossoms occupies similar spots farther east. From June until frost, verbenas in the garden put forth clusters of showy fragrant bloom in all shades from white through lilac and purple to dark purplish blue, as well as pink or yellow.

Roadsides and waste places make a place for the humble blue vervain (*V. hastata*) with spikes of small dark-blue flowers, which merits attention for its reputation among the ancient Romans as a medicinal herb, and with the Druids of Gaul as useful in incantations.

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VIVID CLUSTERS OF MEADOW PHLOX (1) SPLASH DRY FIELDS WITH COLOR

Phlox pilosa is a member of a plant genus so widely distributed that it has been suggested for the national flower of the United States. Two Figworts are (2) **Pink Gerardia,** *Gerardia tenuifolia,* and (3) **Yellow Wood Betony,** *Pedicularis canadensis,* with small plumelike blossoms. (4) **Hairy Ruellia,** *Ruellia ciliosa,* is a member of the Acanthus family. The huge Asiatic teak tree and delicate (5) **Prairie Verbena,** *Verbena bipinnatifida,* are related.

MINT FAMILY

(*Menthaceae*)

The mint family needs no introduction, since it is famous the world over for the fragrant volatile oils of peppermint and spearmint, for the savory leaves of thyme, sage, and rosemary, and for many handsome garden plants and wild flowers.

What would the plantation garden of the Old South have been without its bed of mint for juleps?

These two-lipped blossoms borne in stiff spikes have reached such a degree of perfection in their adaptation to the visits of pollinating insects that bees rarely fail to be dusted with pollen on entering the tube of the flower, or to deposit it in turn on ripe stigmas of others. As a result, four sturdy little nutlets in each seed pod suffice for the success attained by the mints in populating the earth.

Wild Bergamot

Maine to Ga.; west to Tex. and B. C.

This wild bergamot (1) has traveled widely, but whether its favorite dry plains and prairies be in Canada or Texas, Maine or Alabama, the bright rose-purple clusters are eagerly sought by bees, butterflies, and hummingbirds. A wild bergamot of moist woods in the East, which is known locally as "oswego tea" (*M. didyma*), is especially gorgeous with flowers of brilliant red; lovely tints of pink, lilac, rose, or crimson are favored by the monarda of meadows of the Middle West and a variety (*M. media*) to be found in moist thickets farther east. In comparison with these gaily colored beauties, the horsemint (*M. punctata*) of sandy soils seems little more than a homely weed, for the flowers are pale yellowish, spotted with purple, but it yields a fragrant oil.

Hedge Nettle

Newfoundland to N. C.; west to Minn., Colo., and w. Canada

The square stems of this mint (2) may rise stiffly from moist places in almost any part of the country, as also in Europe and Asia. The flowers are arranged at regular intervals along the stem in prim clusters to which the scientific name *stachys*, "spike," refers.

Individually, the pale rose-lavender blossoms, prettily speckled with a deeper shade of the same color, and with long drooping lower lip and tiny hooded upper petal, have a delicate charm much like that of the far-western woodmint (*S. bullata*).

Prairie Sage

Neb. to Tex., and Colo.

In late summer and early autumn, long spikes of blossoms add touches of an exquisite and unusual shade of blue to field and roadside where the prairie sage (3) may have found a foothold. The foliage, downy with soft hairs, is grayish green, and the plants, more or less branched, sometimes reach a height of three or four feet.

The flat lower lip of the corolla affords a conveniently broad landing platform for the visiting bee, which, on entering the tube of the flower, brushes against the pollen sack above its head. This is attached by a tiny hinged lever which is set in motion at the slightest touch and shakes a shower of pollen down upon the bristly head or back of the nectar seeker. The intruder unwittingly carries a load of pollen to the stigma of the next flower and thus brings with it more than it takes away. So perfect is this mechanism that cross-pollination among the mints rarely fails.

Dragonhead

Quebec to Fla.; west to Tex. and Kan.

This attractive plant (4), having clusters of rose-purple flowers with oddly shaped corollas which have been likened to the head of a dragon, has run away from gardens and taken root in moist soil here and there in the eastern half of the country. It has rather few close relatives, numbering about seven species in North America and some abroad. A few have been found useful in medicine, and one in Siberia is brewed into a tea.

Prunella

Newfoundland to Fla.; west to Calif. and B. C.

The round clusters of purple prunella flowers (5) bloom inconspicuously in fields, woods, and grassy places throughout the country and attract attention more by reason of their quaintness than for any brilliance of coloring or beauty of form. The individual blossom has the flat, drooping lower lip of a typical mint, and the hooded upper one within which two stamens are protected against wetting.

Like many mints, prunella has achieved some reputation in medicine. To this the name bears witness, for it is derived from the German word for "quinsy," and the drug is listed in the pharmacopoeia of today.

These diminutive plants are suitable for rockeries or slightly shaded borders and will thrive in almost any soil that is not too dry.

Skullcap

Newfoundland to N. C.; west to Ariz. and Alaska

Skullcap flowers (6) have the flaring lower lip and hooded upper one which characterize the family of mints, but the calyx is so oddly shaped as to set them apart in a separate genus, and also to suggest the name for the group.

The members of this genus are widely distributed over the globe on dry plains, rocky banks, swamps, or gravel slides. The blossoms are usually of some shade of blue or purple, but in some cases are whitish, yellow, or reddish.

The large blossom of the hyssop skullcap resembles a visored helmet.

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GOOD LOOKS RECOMMEND THESE RELATIVES OF USEFUL MINTS

On dry plains and prairies from Canada to Texas flourish (1) **Wild Bergamot,** *Monarda mollis,* a favorite source of nectar for hummingbirds, butterflies, and bees. Characteristic of the Mints are square stems, pairs of opposed leaves, and flowers borne in stiff spikes: (2) **Hedge Nettle,** *Stachys palustris,* (3) **Prairie Sage,** *Salvia pitcheri,* and (4) **Dragonhead,** *Dracocephalum virginianum.* (5) **Prunella,** *Prunella vulgaris,* and (6) **Skullcap,** *Scutellaria galericulata,* are less conspicuous cousins.

PEA FAMILY

(*Fabaceae*)

From the tiniest of psoralea blossoms, scarcely one-eighth of an inch across, to the magnificent Spencer sweet peas of the florist, twenty times as large, the members of this family show wide gradations in size, as well as an infinite variety of colors. But with certain exceptions the flower itself exhibits the familiar butterfly form throughout this vast group. It is made up of a bright banner in the usual shape of a broad upright petal, a keel fashioned from two others to resemble that portion of a boat and flanked or often concealed by the two remaining petals known as "wings."

A tiny ovary, which will develop into a pod full of peas or beans, and ten stamens as a rule are so snugly packed away in the keel that it is often only with great difficulty that even the strongest bees can reach the nectar. For the most part the stamen filaments are united into a tube, leaving one free to form a slit for the tongue of bee or butterfly as it probes for sweets.

This family is sometimes divided into three, one containing the sensitive plants, acacias, and their relatives; another the cassias, dwarf and royal poinciana, and the redbuds; and the third, and much the largest and best known, the peas, vetches, clovers, lupines, etc. The simplest flower is that of the acacia, with many stamens and no hint of banner, keel, or wings. The exotic and native sensitive plants have merely reduced the stamens to 10 or less.

The petals become somewhat irregular in cassias and paloverdes, and are distinctly pea-like in the redbud. Close to these among the true peas are the wild indigos, with ten separate stamens, and lupines with them all united into a tube.

There are only two or three other flower families that equal this in size, world-wide distribution, and economic importance. Nutritious foods and fodders, drugs, dyes, poisons, oils, and woods are among its contributions to mankind, not to forget the services rendered by the nitrogen-fixing bacteria of the roots, which enrich the soil and thus serve as nurse crops for other plants, grasses especially.

Sensitive Brier

Va. to Fla.; west to Tex. and Colo.

The feathery rose-purple balls of sensitive brier (1), dotted over with tiny bits of orange-yellow pollen, have failed to retain the family tradition of the "butterfly" pea flower, and hence are placed with the mimosas and acacias in a special group of their own within the larger limits of the family proper.

The weak stems, thickly set with sharp, hooked spines and pretty foliage, trail over the dry soil of midwestern prairies. The leaves, made up of tiny leaflets, are so sensitive to shock that the slightest touch will cause them to fold together and droop on the stalk. The true sensitive plant (*Mimosa pudica*) comes from tropical America and has flowers only one-third to one-half as large as those of the sensitive brier.

Pink Krameria

Fla. to N. M.; north to Kan.

Krameria departs from the usual by wearing a unique shade of wine red in blossoms that appear like five-pointed stars (2). They have little in common with the sweet pea and its relatives, with their butterflylike flowers, but do bear some resemblance to the simpler members of the family, such as the cassias or partridge peas. The petals differ in size and shape, and the stamens are only four instead of the usual ten.

The fruits are round and barbed, and do not open as does the typical pod of the peas; hence it is easy to understand why botanists disagree about the relatives of this plant, some including it among the simple peas and others placing it in a separate family in their neighborhood.

This species is an herb that is particularly fond of sandy prairies in and about the "Dust Bowl," where it crawls over the soil with a wealth of blossoms in May and June; but the other species are mostly denizens of the deserts of the Southwest. Like other dwellers in hot climates, it has stems which have become woody to form low spiny shrubs, while the leaves have dwindled almost to nothing in face of the need to conserve water.

Blue Wild Indigo

Pa. to Ga.; west to Ind., Kan., and Ark.

Wild indigo flowers are among the handsomest of our natives, for not only are the individual blossoms of unusual size, but they also occur in dense clusters a foot or so long, and are a rare shade of very dark blue (3). The plants are low-growing with attractive foliage, and since they will thrive in ordinary soil with no special treatment, they make excellent subjects for garden culture.

Yellow or White Wild Indigo

Mich. to Minn.; south to La. and Tex.

There are a number of yellowish-flowered wild indigos at home in different parts of the country, but this species (4) is one of the most showy, since the pale cream-colored blossoms are not only unusually large but are arranged in nodding clusters that almost rival those of the wistaria in size. They sometimes grow side by side with the blue wild indigo (3) on midwestern prairies, and are equally easy to introduce into gardens, where they occasionally hybridize with each other.

The wild indigos are most abundant in the southern States, where one species was formerly used in dyeing. However, the indigo of commerce comes from tropical species which are somewhat distant relatives.

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BUTTERFLY BLOSSOMS TYPIFY THE USEFUL PEA FAMILY

Foods and fodder, drugs and dyes, are some of the contributions of this plant group to mankind. An exception to the common butterfly form of flower is the feathery (1) **Sensitive Brier,** *Schrankia uncinata,* whose leaves fold and droop at a touch. Large showy blooms cluster thickly on stems of (3) **Blue Wild Indigo,** *Baptisia australis,* a source of medicinal drugs, and (4) **Yellow Wild Indigo,** *Baptisia leucophaea.* (2) **Pink Krameria,** *Krameria secundiflora,* belongs to a closely related family.

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LOVELY LOCOWEEDS (1, 2) LURE HORSES AND CATTLE TO THEIR DEATH

When feed is scarce, stock acquires a fatal taste for these two poisonous Peas. Less harmful than (1) **Pink Loco,** *Oxytropis lambertii,* is (2) **Purple Milk Vetch,** *Astragalus adsurgens.* Prairie dogs store pods of (3) **Ground Plum,** *Astragalus crassicarpus,* for winter fare. (4) **Pink Prairie Clover,** *Petalostemum purpureum,* has straight and narrow leaves. Blossoms of (5) **Purple Amorpha,** *Amorpha canescens,* wear a "halo" of orange stamens.

Pink Loco

Manitoba to Mo.; west to Colo. and Mont.

The pink loco (1) is one of the most attractive of all the so-called "locoweeds," and its large spikes of vivid rose purple make bright patches of color during the long warm summers on the plains and prairies.

Often in the plant world, as among the races of man, a fair exterior is no guarantee of inner worth, and this is eminently true of this section of the pea family, known as "locoweeds" or "crazyweeds," for death by slow poison lies in wait for man or beast that may be inclined to feast upon the foliage.

Fortunately, this offers no attraction to the palate of mankind, and little at first to that of his livestock. However, all too often have the latter been tempted, because of lack of other more palatable feed, to nibble at the leaves, with the result that as enslaving a habit is formed as the morphine habit acquired by man.

Losses to stockmen in consequence of the effects of continued indulgence of a taste for locoweeds on the part of cattle, horses, and sheep have amounted to more than a million dollars, and large bounties have been offered by State governments for an effective method of avoiding such loss. Unfortunately, the many chemists who have sought to determine definitely which of the substances in the plant constitute the active poison have as yet failed of complete success.

The effects, however, have been established beyond a doubt, and are such as to give the name of "loco" or "crazy" to the plant, for its addicts stagger about unable to control their muscular or nervous reactions. They become gradually more and more emaciated, and eventually die of starvation.

It is the white form of this locoweed that causes the greatest damage, since it is much more abundant, remains green all winter on the Texas plains, and seems to be considerably more attractive to all kinds of grazing stock than some of the other species.

Purple Milk Vetch

Manitoba to Minn.; west to Colo., Ore., B. C.

The purple milk vetch (2) shares in the evil repute of other locoweeds, although it seems less harmful than many, and much less so than its very near relative, the purple locoweed (*A. mollissimus*), which is especially abundant in Texas. The latter has brown pods and flowers of deep purple, and is apparently relished more by horses than by cattle.

There are a number of other species of astragalus growing on the plains, prairies, and meadows of the Middle West, which differ from each other mainly in the amount of hairiness, shape and size of leaflets, color of flowers, and size of pods, but all possess the typical "butterfly" flowers that distinguish members of the pea family.

Many kinds of locoweeds are cultivated in the Old World, but comparatively few in America despite the presence of numerous species, some of them very handsome and well suited to the flower garden.

Ground Plum

Manitoba to Mo.; west to Tex. and Mont.

This member of the group of so-called "crazyweeds" provides the exception to the rule, for, far from being poisonous, its fruits are quite edible (3). These take the form of thick, succulent pods which are more or less pleasant to the taste and have long been sought by prairie dogs as a desirable addition to their winter store of food. At one time these fruits were under experimentation at the hands of scientists in the United States Department of Agriculture, with a view to increasing their size and succulence and eliminating a certain bitterness, in the hope that they might be more suitable for mankind.

In some species the fruits are beautifully speckled or banded with reddish purple, while others are papery in texture and inflated so that they make excellent "poppers" when crushed.

Pink Prairie Clover

Manitoba to Ind.; west to Ark., N. M., Sask.

Prairie clovers may be white, pink, purple, or violet, and although there is little in the narrow-clawed petals attached to the stamens to remind one of the "butterfly" flower of the true clovers, nevertheless a close relationship exists (4). The name *Petalostemum* is a Greek word referring to the peculiar union between the stamens and petals which distinguishes prairie clovers from other genera of the family.

Throughout July and August on the plains and prairies of the Middle West, the low-growing clumps with finely cut leaves put forth a succession of showy spikes of rose-purple blossoms. A white-flowered species (*P. candidum*) may usually be found near by, but it shows a definite preference for moister soil, so that the two rarely intermingle.

Both these prairie clovers are sufficiently ornamental to be worthy of cultivation in rock gardens or borders, for the foliage is attractive and a succession of delicately tinted blooms may be counted upon.

Purple Amorpha

Manitoba to La.; west to N. M. and Mont.

Silvery-leaved, low-growing shrubs, bearing spikes of blue-purple blossoms with orange stamens, add a touch of distinction to midwestern prairies when the amorphas come into bloom (5). This pretty scientific name means "without form" and indicates that the flowers differ not only from the "butterfly" flower of regular peas, but also from the fluffy balls of the sensitive brier and the star-shaped blossoms of krameria. Each amorpha flower possesses but one tiny petal, but so many of them are crowded closely together in a long spike as to make a good midsummer showing.

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WILD COUSINS OF THE GARDEN SWEET PEA PAINT THE PRAIRIES

Patches of (1) **Ornate Sweet Pea,** *Lathyrus ornatus,* and (2) **Goatsrue,** *Tephrosia virginiana,* touch with color unsightly embankments, gullies, and abandoned fields. Trailing (3) **Vetch,** *Vicia americana,* "feels" its way with curling tendrils. Tiny purple blossoms of (4) **Prairie Psoralea,** *Psoralea tenuiflora,* are a foil to bright golden flowers of (5) **Partridge Pea,** *Cassia chamaecrista.*

Ornate Sweet Pea

S. D. to Okla.; west to Colo. and Wyo.

Although not so large or variously colored as the cultivated sweet pea, this little cousin of the open prairies is of sufficient size and depth of color to cast a purple tinge over areas massed with its bloom (1). Railway embankments, roadside ditches, and midwestern prairies that offer adequate moisture may be clothed in a favorable season with the pretty leaves and delicate two-toned blossoms.

The task of pollinating some of the peas presents unusual difficulties to the busy bee, for the nectar is concealed within the tightly closed "keel" at the base of the stamens. In order to reach it, the bee rests on the two wing petals, braces its head against the standard, and by pushing vigorously may succeed in depressing the keel far enough to permit the tongue to enter the opening. As the keel is lowered, the stamens are forced out and up against the body, where the pollen is then deposited.

Relatively few insects are sufficiently strong to accomplish this result, and pea flowers have in consequence perfected the mechanism for self-pollination to such a degree that many are independent of insects.

The beach pea (*L. maritimus*) of eastern lake shores or sea beaches is so similar in size and coloring to this ornate sweet pea farther west as to be scarcely distinguishable, and the crimson sweet pea (*L. splendens*) of southern and Baja California differs in nearly every respect. It is the finest of all wild specimens, with large clusters of blossoms of unusual size and deep-crimson color. The long trailing stems clamber over shrubs on coastal hills to a height of ten feet or more, and bear a profusion of gorgeous bloom that is the wonder and admiration of all beholders.

Goatsrue or Cracca

Maine to Fla.; west to Tex. and Manitoba

The flowers of this lovely plant, known also in common parlance as "hoary pea" and "catgut," resemble those of true sweet peas to a marked degree (2), though the plant has no tendrils with which to climb. The Latin name *cracca* means "vetch."

As yet this charming flower has not been introduced to culture, but the home gardener in search of something new may well find it worth experimenting with for massed effects on dry sunny slopes.

Vetch

New Brunswick to Va.; west to Ariz. and B. C.

The rose-purple and pale-pink butterfly blossoms of the American vetch perch on trailing stems which clamber over low shrubs or bushes by means of curling tendrils (3). Meadows or moist soil afford this little traveler satisfactory homes the country over, but it has no objection to settling down in garden soil if given the least encouragement.

The common vetch (*V. sativa*) is cultivated as a forage crop abroad as well as in this country, where it also serves as a cover crop in orchards. The best-known species for agricultural purposes, however, is probably the Windsor bean (*V. faba*), which is used as food by Europeans, but is grown for cattle feeding in regions of the United States where summer temperatures do not climb excessively high.

The seeds may be an inch or more across in pods a foot or so in length, and although suspected of poisoning anyone who eats them before they are fully ripe, they seem to have been in use since prehistoric times.

The European species of vetch have often escaped from fields into waste places, but, unlike many of the other plant immigrants to our shores, they rarely become obnoxious here.

Prairie Psoralea

S. D. to Tex.; west to Ariz. and Mont.

These blossoms of dark blue-purple that cluster loosely on silvery stems are of the smallest and yet each is a perfect butterfly flower with standard, wings, and keel within which ten tiny stamens and a wee pod lie snugly housed (4). This species forms one of the most familiar societies of prairies and plains, with both plants and blossoms attaining a larger size where the rainfall is greater. They offer some danger of poisoning to stock, but only when other feed is scarce.

A number of Psoraleas have been used in medicine; one has furnished fiber to California Indians; and the pomme blanche (*P. esculenta*) was known both to the aborigines and to early French voyageurs as having edible tubers.

Partridge Pea

Maine to Fla.; west to Colo. and Minn.

The Cassias are lovers of sunny places and it is not unusual to find the partridge pea (5) forming dense masses in sandy fields or dry open areas in the eastern and middle-western parts of the country. The showy flowers of a rich golden yellow, frequently decorated with a purple spot at the base of each petal, spring from short stalks in the axils of the finely cut leaves. They are unusually ornamental and well fitted to form in a short time an attractive feature of sandy roadsides.

The sensitive nature of this species apparently varies with conditions, since the leaflets on plants in the drier part of its range respond only slightly when touched vigorously, though they will close rapidly when a branch is plucked from the parent stem.

Most of the species of Cassia are tropical, and it is from the leaves of natives of far-eastern Syria and Arabia that the drug known as "senna" is derived. The partridge pea may contain some trace of a similar constituent, since it cannot be eaten safely by stock.

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WITCH HAZEL (1) WITHHOLDS ITS RIBBON FLOWERS UNTIL THE EVE OF WINTER

Fluttering yellow fringes of *Hamamelis virginiana* gleam above bright autumn leaves. Its bark and leaves yield witch-hazel extract. The crinkled, square-faced flowers of (2) **Trumpet Evening Primrose,** *Oenothera lavandulaefolia,* change from yellow to reddish brown as they wither. By opening its blossoms in the morning, the (3) **Prairie Evening Primrose,** *Oenothera serrulata,* belies its name. (4) **Scarlet Gaura,** *Gaura coccinea,* is a third member of the Evening-Primrose family.

WITCH HAZEL FAMILY

(Hamamelidaceae)

The witch hazel family has few representatives in North America, the majority being natives of Japan, India, and Cape of Good Hope. Among them all, our liquidambar, or sweet gum, stands out as the most beautiful. It has fine-grained wood and fragrant leaves which take on such brilliant colors in autumn in this country that the trees stand out conspicuously in the swampy woods of the East.

Witch Hazel

Nova Scotia to Fla.; west to Minn. and Tex.

Low-growing witch hazel shrubs (1) delay their blossoming until the bright-hued leaves of autumn strew the ground and trees and shrubs stand stark and bare. Then, out from tight brown buds in cream-colored calyx cups, unfurl narrow ribbonlike petals of pale yellow. There are only four to a flower, but the clusters make a beautiful showing of wavy fringe and spots of color in the winter woods. It is not until the following autumn that the seeds ripen in the pods, which then pop open with such vigor as to scatter the contents briskly to some distance in all directions.

The seeds contain a useful oil, and both leaves and bark are sources of the popular extract of witch hazel.

Witch hazel shrubs come into bloom in late fall and early winter when scarcely any other shrub still retains its flowers. The blossoms of some of the species in northern latitudes are not injured even when the temperature falls to zero. Before the flowers appear on bare branches, the leaves make a brave showing of color by turning bright yellow, orange, or purple.

EVENING PRIMROSE FAMILY

(Onagraceae)

The flowers of this family are not primroses, nor do most of them open in the evening; neither does their preferred time of blooming correspond to the original meaning of the word primrose as indicating "the first flower of spring." Nevertheless, as with many common names of plants, the name "evening primrose" has come to set apart a large group of striking flowers, many of which blossom in the morning or evening to last but a single day.

At first glance, the flower of an evening primrose might be mistaken for one of the mustard family, since both have four petals placed at right angles to each other. But here the resemblance stops, for in the evening primrose the petals are borne on the long calyx tube which crowns the ovary, and the stamens number eight. The calyx tube may reach half a foot in length in some species, but in such a case the nectar may rise an inch or more so that it can be sipped by long-tongued moths.

A number of unusually showy species are to be found within the limits of the evening primrose family, including the rose-purple Clarkias and Godetias of California, the Fuchsias, Epilobiums, Lopezias, and Oenotheras. Of the latter, the yellow evening primrose (*O. missouriensis*) of limestone cliffs and barrens in the Middle West and Southwest, bears blossoms sometimes six inches across.

An almost equally large-flowered species (*O. caespitosa*) of western hills and the Rocky Mountains unfolds crinkly white petals in from two to seven minutes as dusk begins to fall. Sphinx moths await access to the honey, and after their visits the flowers gradually droop, fading to a rosy pink by morning.

Trumpet Evening Primrose

S. D. to Tex.; west to Ariz. and Wyo.

The decumbent plants of the trumpet evening primrose (2), with clusters of narrow leaves, may be found in open sunny places throughout the plains and prairies of the West and Middle West. The flowers are borne in the axils of the leaf clusters at intervals along the stem, where they bloom in succession from the lower part toward the upper end. Thus one may see at any one time an unopened bud with enclosing calyx colored rose purple and green stigma emerging at the pointed tip; a full-blown blossom whose silky crinkled petals bend back sharply from the "trumpet tube" to reveal eight anthers bursting with yellow pollen; and an older flower that changes from bright yellow to reddish orange as it wilts and fades.

Prairie Evening Primrose

Manitoba to Mo.; west to Tex., Ariz., Alberta

This little evening primrose (3), with bright-orange buds, blossoms of cheery yellow, and leaves cut into teeth along the edges, blooms from May to July in the dry soil of the prairies. It should, however, be called "morning primrose," since the flowers reverse the order of blooming by opening in the morning and closing in late afternoon.

The common evening primrose (*O. biennis*), however, is more orthodox, opening at dusk and so quickly that the movement is plainly evident. Hawk moths are fond of this denizen of waste places and flutter about as the daylight wanes, awaiting the opening of bright-yellow blossoms well supplied with nectar.

The root of this species is sweet and edible, and the plant yields a remedy used for coughs and asthma, but on the whole evening primroses have no economic value.

Scarlet Gaura

Manitoba to Tex.; west to Ariz. and Mont.

Gaura flowers individually have a quaint and delicate charm, but they make no great showing as loose clusters on rather rangy, leafy plants (4). The color is normally a pale coral pink, but as the petals age they take on a deep scarlet tinge that increases their attractiveness, especially as stems and capsules are often reddish also, and the anther sacs are crimson.

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BLOOMS BURST FROM SPINE-GUARDED "WATER BOTTLES"

Members of the Cactus family have merged stems, branches, and leaves into tough-skinned, bulbous reservoirs. If unchecked (2) **Western Prickly Pear,** *Opuntia humifusa,* and (3) **Spiny Prickly Pear,** *Opuntia polyacantha,* overrun the land and ruin it for grazing. (4) **Purple Cactus,** *Mamillaria vivipara,* displays asterlike flowers. At dusk, (1) **Evening Star,** *Mentzelia ornata,* unfolds creamy blossoms. (5) **Meadow Beauty,** *Rhexia virginica,* bears its family name.

EVENING STAR FAMILY

(*Loasaceae*)

Evening stars constitute a small but interesting family characterized by stinging or barbed hairs on stems and leaves, and beautiful star-shaped flowers. The barbs are small enough not to cause wounds, but sufficiently numerous to impart a roughness to stems and leaves which enables them to cling closely to whatever they touch. A boutonnière of mentzelia blossoms needs no fastening other than firm pressure against the clothing.

Evening Star

Manitoba to Iowa; west to Tex., Nev., Alberta

Night-flying insects are attracted by the fragrance of the large cream-colored blossoms of this evening star (1), as the petals fold back in late afternoon or early evening and reveal an abundance of pollen on the dense clusters of stamens in the center. The foliage of these stately plants may likewise claim a share of beauty, for the prettily scalloped leaves are silvered over with hairs which feel rough to the touch, and the stems or pods often show a flush of pink.

An especially beautiful evening star (*M. aurea*) of the Pacific coast should be rechristened "morning star," since it prefers to reverse opening and closing times. It too is fragrant, but differs in having a smaller number of broader petals of rich yellow and orange-red centers. Gravel slides in the Rocky Mountains are often starred over in early summer evenings with bright-yellow ten-pointed blossoms of another evening star (*M. multiflora*) on stems that stick to clothing most tenaciously.

CACTUS FAMILY

(*Cactaceae*)

Since the cactus craze has swept the country of recent years, one scarcely needs a formal introduction to this family of spiny plants of weird and fantastic shapes, which produce blossoms of such unrivaled beauty. Cactus plants have no true leaves, but their stems and branches have been developed into reservoirs of water stored against the demands made by the heat and drouth of the desert climates where they are most at home. They may take the form of rotund barrels, or of immense branched trees towering up thirty or forty feet; some appear like rows of organ pipes and others like stunted shrubs bristling with spines. Many have fruits that are eaten by natives of the Tropics or exported to other regions, and the spineless forms may be used as fodder for cattle.

Western Prickly Pear

Minn. to Tex.; west to Colo. and N. D.

Prickly pears had long been cultivated by the aborigines of this country when the early Spanish explorers appeared. Attracted by their edible fruits and odd appearance, they took the plants to Spain and Spanish colonies, whence the culture eventually spread to all arid and semiarid countries. Wherever grown, however, the plants show a tendency to escape and become persistent and troublesome weeds.

Undesirable though the prickly pear may be from the point of view of agriculture and grazing, there is no doubt that the large silken-petaled blossoms of clear lemon yellow (2) or glowing magenta pink are exquisitely beautiful.

Spiny Prickly Pear

Minn. to Mo.; west to N. M., Utah, B. C.

All opuntias, or prickly pears, have about the same qualities as those mentioned above, though only a few of the species are chosen for cultivation. The finest nowadays are grown in Sicily, where they are used as food.

The spiny prickly pear (3) is so abundant in some parts of middle-western plains, especially where cattle have eaten out the grasses, that it threatens to ruin the land permanently. Over vast areas the plants grow so thickly that it is difficult to find one's way between them. Methods of eradication and control are being tried out today, but as yet nothing completely satisfactory has been discovered.

The yellow prickly pear (*O. engelmanni*), in addition to possessing edible fruits, is an excellent honey plant, especially in Texas, where it is unusually abundant.

Purple Cactus

Manitoba to Kan.; west to Colo. and Alberta

Mamillarias may be recognized by the small globular stems carved into nipplelike protuberances, and by flowers with several rows of narrow petals. The purple cactus illustrated (4) belongs to this group and is to be found in dry or rocky soil of western plains. It never becomes so abundant as the prickly pears, but the flowers are individually attractive, with silken petals of brilliant magenta.

MEADOW BEAUTY FAMILY

(*Melastomaceae*)

This family of tropical plants is represented in our country by a scant number of species that have found sandy swamps and shores or boggy places suited to their needs. Certain drugs, oils, and dyes are to be had from some of them, and an unusual edible berry that dyes the mouth black. The Greek name for the family refers to this peculiarity, for *melastoma* means "black mouth."

Meadow Beauty

Maine to Fla.; west to La. and Iowa

This meadow beauty (5), with bright rose-purple blossoms and reddish urn-shaped calyxes, associates with pitcher plants and cranberries in low meadows or bogs throughout the East and Middle West. It is a favorite in English gardens and should also find favor in this country, since it is one of the few herbaceous species in a family of tropical shrubs.

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HERALD OF SPRING IS THE EXQUISITE TRAILING ARBUTUS (2)

In evergreen woods of the North and East, fragrant clusters of *Epigaea repens* appear as soon as the snow melts. The drooping blossom of (1) *Moneses uniflora,* and nodding flowers of (3) **Green Pyrola,** *Pyrola chlorantha,* hide in moist and shady woodlands. These first three belong to the Heath family. A member of the Bellflower clan is (4) **Bluebell,** *Campanula rotundifolia.* Among the Lobelias are (5) **Cardinal Flower,** *Lobelia cardinalis,* and (6) **Blue Lobelia,** *Lobelia syphilitica.*

HEATH FAMILY

(*Ericaceae*)

England, Scotland, and northern Europe may justly take pride in the rosy carpet which the true heaths and the heather spread over vast moorlands when the tiny rose-purple bells come into bloom. In contrast to the massed effect of small flowers, our own rhododendrons and azaleas achieve a superb showing by means of large clusters of handsome blossoms.

A further contrast is offered in the quality of honey obtained from each. That from wee heather blossoms is sparkling in color and of an unusual fragrance and flavor; that which their magnificent cousins on this side of the water produce is extremely poisonous. The army of Xenophon is said to have been severely poisoned by eating a honey from the blossoms of rhododendrons growing on the shores of the Euxine Sea (now the Black Sea).

Other poisonous members of the heath family are the kalmias, frequently called "lambkill" from the effect they have on grazing animals. On the other hand, this family also contributes some of our choicest fruits, such as huckleberries, blueberries, and cranberries.

Moneses

Greenland to Pa.; west to Colo., Ore., and Alaska

The Greek name "single delight" aptly designates this tiny heath (1) with fragrant waxy-white or rose-tinted blossom on bent stem, for there is only one flower to a plant and it is indeed charming. It is a shy and solitary plant, found growing in moist, cool woods of the North, on brook banks in spruce forests of the Rocky Mountains, or in similar places in Europe and Asia.

Trailing Arbutus

Newfoundland to Fla.; west to Ky. and Sask.

As soon as the snows have melted, one may seek the exquisite clusters of pale pink, spicily fragrant blossoms of trailing arbutus (2) in the evergreen woods of the country bordering the Great Lakes, especially where the soil is somewhat rocky or sandy. If some care is taken in removing a large portion of the soil around the roots so as not to disturb them, the plants may be coaxed to grow in the garden, especially if placed to root in a cold frame where there is little or no sunlight, in sandy peat soil mixed with a little loam.

Green Pyrola

Labrador to D. C.; west to Calif. and B. C.

The pyrolas are all lovers of cool woods, where their straight, rather stiff stalks rise from clusters of evergreen leaves and bear small nodding flowers in a vertical row. In some species these may be cream-colored; in others pink; but all are delicately tinted (3). As a rule, they possess little nectar or other attractions for insects, and in consequence have perfected a method of their own for effecting self-pollination.

BLUEBELL FAMILY

(*Campanulaceae*)

The flowers of bluebells and lobelias look quite different in external appearance, but in both groups the corollas are attached on top of the ovary, and there are other important similarities of structure which warrant their being placed in the same family. They are also alike in possessing a milky juice in stems and leaves, but that of the bluebells is harmless, while the juice from the lobelias will blister the skin and cause serious internal inflammation.

Both groups provide the florist or home gardener with charming varieties, of which the huge clusters of the Canterbury bell, the scarlet cardinal flowers, and purple lobelias are the most beautiful and popular.

Bluebell

Labrador to N. J.; west to Ariz. and Calif.

The lavender-blue, perfect bell flowers of this bluebell (4) may nod a greeting from grassy slope or rocky bank almost anywhere in the Northern Hemisphere, for it is found the world round in favored spots. On the middle slopes of the Rocky Mountains of Colorado the plants grow tall and slender and produce many blossoms; but in alpine meadows the stems are only a few inches in height, with but a single large flower to a plant. In addition to an enormous variation in size of flower, from a quarter of an inch to an inch in length, there is an equally striking variability in form, from shallow, almost saucerlike corollas to deep goblet- or narrow tube-shaped ones.

These differences are responses to the amount of water available during the season, or in local situations where the particular plant grows. An individual rooted on a warm slope where the soil water evaporates quickly will produce smaller flowers than one in moist shade.

Cardinal Flower

New Brunswick to Fla.; west to Tex., Colo., and Sask.

Showy clusters of brilliant vermilion-red flowers on tall, leafy stems mark the spots in the East and Middle West where the cardinal flower (5) finds moisture to suit its needs. Hummingbirds, always attracted by this color, wing their way unerringly to the nectar and with their long bills find no difficulty in reaching it at the bottom of the slender tubes.

Blue Lobelia

Maine to Ga.; west to La., Colo., and S. D.

The blue lobelia (6) equals the cardinal flower in size and beauty of flower, but offers a striking contrast in color, since it is intensely blue. Moist soil in the native haunts is favored by the leafy-stemmed plants with blossoms in dense racemes and they do well in gardens.

ASTER FAMILY
(*Asteraceae*)

The aster family comprises within its wide limits an enormous number of species of every degree of attractiveness, from tiny greenish wayside weeds such as the ragweed, whose windborne pollen is a trial to hay-fever sufferers, to magnificent dahlias and chrysanthemums.

Among such a host are many that are useful as tonics, drugs, or stimulants, food and forage, dyes, medicines, beverages and poisons.

Together with the grasses, the asters, or "composites," as they are sometimes called, bid fair to inherit the earth and in time to eliminate competitors in the plant world. Hence the need of conserving less hardy wild flowers that suffer in the struggle for existence.

Despite the striking differences in outward appearance of these two most successful groups of flowering plants—the asters and grasses—both have developed in their inflorescences communities of flowers that specialize in the processes that go to produce numerous strong seeds. For instance, the aster community is represented by what a casual observer would consider a single flower, but which is called a "composite head" by the botanist and is made up of a large number of individual flowers.

Part of the success attained by the asters in producing many new plants and spreading rapidly is due to the fact that this group of seed-making flowers matures successively from the outer edge of the disk toward the center. The result is that pollen is produced over a long period with greater certainty of fertilization being accomplished by the many more visits, necessitated by this habit, on the part of the bees and butterflies.

The last touch of efficiency in this flower community may be found in the new duties assigned to the calyx of each blossom. This little "cup" of green leaves is considered to act as a protective and food-making device for most flowers, but aster flowers are crowded so closely together in a head that they protect one another, and already have plenty of food supplied by the other green leaves of the plant, especially those of the involucre. Then the calyx often develops into a device for carrying the ripe seed to its new home, or into hooks and spines which carry beggar-ticks far and wide to start communities in other regions.

Rose Gaillardia

Neb. to La.; west to Colo. and Ariz.

The dull expanse of short-grass plains in the south-central part of the country may be splashed with great patches of vivid color when the rose gaillardia (1) comes into bloom. The plants are especially abundant in Texas, where they constitute a source of excellent honey.

The flower heads are reddish purple with yellow tips to the rays, whereas the perennial gaillardia (*G. aristata*) of western plains has orange-red centers and bright-yellow rays, often with a crimson spot at the base.

Rose Coneflower

Colo. to Tex.; west to Mont. and Sask.

The stout stems of the coneflower stand stiffly here and there in the vegetation of the prairies and for two months or more of summer bear large heads with prickly red-brown centers and long, drooping rays of pale pink or rose color (2). A somewhat deeper hue is worn by the purple coneflower (*E. purpurea*). of rich, moist soil in the East and Southeast.

The sharp angle at which the rays hang, and the high, conically shaped center distinguish these coneflowers from the closely related black-eyed Susans, which are sometimes called "coneflowers" also. Their centers, moreover, are not so high and are soft to the touch, while this genus, named *Echinacea* from a Greek word meaning "hedgehog," has rounded centers that are distinctly prickly to the touch.

Blue Lettuce

Saskatchewan to Mo.; west to N. M., Calif., British Columbia

The blue lettuce (3) still runs wild in prairies and wet meadows, although its sister, the garden lettuce, has been in captivity ever since 400 B.C., when records indicate it was served at the tables of Persian kings. Under cultivation the leaves have developed at the expense of the flowers.

The Latin name for lettuce is derived from the word for "milk" and refers to the thick white juice which exudes from broken stems and is said to have been used for insomnia. Other close relatives of the lettuce are the chicories, with roots that are roasted and mixed with coffee; endive, used in salads; and the oyster plant, the root of which is served as a vegetable.

Golden Ragwort

Newfoundland to Fla.; west to Tex., S. D., Manitoba

The greater number of our ragworts have yellow centers and yellow rays, but the name *Senecio*, derived from the word meaning "old man," has been given to them, since, when the seeds float away, it is by means of a pappus of white hairs, and they leave behind a naked disk more or less resembling a bald head. Many of the plants have a covering of white hairs.

There are many different kinds of ragworts, or groundsels and squawweeds, as they are also called, distributed throughout the country, but the golden ragwort (4) must be looked for in swamps and wet meadows. The strong-scented root was formerly used in aboriginal medicine and is still important in commerce.

Pink Othake

Neb. to Tex.; west to N. M. and Colo.

This pretty plant (5) with the odd name can be found occasionally in the dry soil of midwestern prairies, from July to September.

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HARDY ASTERS LIFT CHEERFUL FACES TO THE SUN

"Carpets" of (1) **Rose Gaillardia,** *Gaillardia pulchella,* cover the plains in the southern Middle West. Prickly "hedgehog" centers and down-curving rays of (2) **Rose Coneflower,** *Echinacea angustifolia,* stand on stout, stiff stems. (3) **Blue Lettuce,** *Lactuca pulchella,* is a cousin of the garden vegetable. Away on "kites" of white down float the seed of (4) **Golden Ragwort,** *Senecio aureus.* Dainty (5) **Pink Othake,** *Othake sphacelata,* blooms on dry soil.

Showy Goldenrod

Nova Scotia to N. C.; west to Ark., Kan., Minn.

Of the numerous species of goldenrod, all but three or four are natives of North America, and each section of our country has its own particular favorites. This so-called "showy goldenrod" (1), however, is fairly widespread, being found in rich soil from Massachusetts and North Carolina in the East to Minnesota, Tennessee, and Arkansas in the Middle West. It is one of the many that cling to the traditional flower cluster of the group.

There are, however, so many species and varieties of goldenrod, with such difficult distinctions between them, that none but the specialist or the honeybee can tell them apart. The latter rarely makes mistakes, and when working on a certain kind will visit it regularly, even though there may be several other sorts in the vicinity.

Other insects with which goldenrods are prime favorites are not so critical and will swarm by the hundred over any and all species. The small green ground beetles and ladybugs are in search of plant lice and insect eggs; the blister and soldier beetles compete with honeybees in seeking nectar, while some very tiny insects end the day's work by crawling deep within the florets to spend the night in cosy comfort. Man utilizes goldenrod tannins and volatile oils in medicine.

Stiff Goldenrod

Ontario to Ga.; west to Ark., Kan., Sask.

The stiff goldenrod (2) is distinguished by the unusual flat-topped form of the flower cluster and also differs in preferring sandy, gravelly, or rocky slopes of hills rather than the moisture of meadow lands.

Goldenrods are so common that it is not often considered worth while to grow them in the garden to any degree. However, they are very easy to transplant from their native haunts, and under cultivation will improve in size and abundance of bloom. They are especially ornamental when planted together with the wild asters invariably found with them in nature, for the yellows of the goldenrods combine most artistically with the purple and lavenders of the asters.

Button Liatris

Minn. to Fla.; west to Tex., Neb., and Manitoba

The species of Liatris are often known as "blazing stars," for no reason that meets the eye, since the flowers are bright rose purple or lavender and not the conventional yellow ascribed to stars. Moreover, the inflorescences are dense spikes, consisting of buttonlike clusters of individual flowers closely crowded on stiff stems, and are not the flat five-petaled blossoms so often alluded to as "starlike."

However, the coloring of the two common species of Liatris is brilliant enough to be termed "blazing," and perhaps especially so since the flowers appear in late summer or early autumn when other blooms have passed out of the picture.

The rose-lavender flowers of the button liatris (3) are crowded thickly together into sheathing cups of brightly colored crimson bracts, and the heads are attached to stiff stems at frequent intervals. Long, slender styles, matching the blossoms in hue, emerge from the mass and intermingle in a way that adds a touch of grace to an otherwise ungraceful plant. This prefers the dry soil of the true prairie of the Middle West, but a similar species (*L. squarrosa*) lives on mixed prairies farther east.

There are a number of races of Liatris differing in leaf form and size of heads, and among them some are hardy perennials well adapted to planting in the wild-flower garden, where they require no special care. Grouped in masses, they form bright patches of color in late summer and autumn when other plants have ceased blooming.

Although of no particular value in supplying man with drugs or food, the rhizomes of several species yield an aromatic drug.

Mistflower

N. J. to Fla.; west to Ark., Kan., and Mich.

An aura of antiquity hangs about this delicately pretty plant of meadow and garden (4). Its scientific name recalls Mithradates Eupator, an ancient King of Pontus, who employed a related species as a counterpoison, thus setting a precedent for its use in modern medicine. The rough joe-pye weed of New England seems to have served the Indian herb doctor in somewhat the same way during pioneer days. The plants are larger than those of the mistflower, and the flower heads are a rich rose purple instead of the misty blue which gives rise to the name for this species, also called "blue boneset."

It is a favorite of old-fashioned gardens, and is popular in some localities as a household remedy. For this purpose a hot infusion or "tea" is made that is considered useful in the early treatment of colds, sore throat, and similar acute infections.

Ironweed

Ohio to Okla.; west to Neb., Kan., Minn.

The dark reddish-purple clusters of ironweed (5) bloom in late summer and may linger on into October, making rich spots of color in fields and roadside ditches when little else is in flower. The plants are large and robust and may be easily cultivated in any rich soil, where they may perhaps best be grouped with other late-blooming composites.

The masses of dark-purple, yellow, and lavender-blue flowers that result, especially when the mistflower is added to the group, are strikingly beautiful, and have the further advantage of providing honeybees with nectar when the supply has been reduced elsewhere.

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TO TELL APART THE MANY GOLDENRODS TAKES A BOTANIST—OR A BEE

Often discriminating honeybees collect nectar from one species at a time. All Goldenrods but one are bright yellow; yet the insects rarely fail to distinguish them. Moist meadows are the haunts of (1) **Showy Goldenrod,** *Solidago speciosa,* while (2) **Stiff Goldenrod,** *Solidago rigida,* prefers sandy or stony slopes. Other members of the Aster family are (3) **Button Liatris,** *Liatris scariosa,* with feathery blooms, (4) **Mistflower,** *Eupatorium coelestinum,* and hardy (5) **Ironweed,** *Vernonia fasciculata,* which decorates fields and roadsides in September.

Smooth Aster

Maine to Va.; west to La., Mo., Colo., and Sask.

Dainty flowers with delicate tints belong to the springtime. A varied host of more brilliant coloring, fitted to survive the heat and dryness of long summer days, then take possession of the fields. Although some may linger on, it is the asters and goldenrods that reign supreme through the autumn. Side by side, these sturdy plants, adapted to warm days and frosty nights, mingle complementary colors of golden yellow with violet or rose purple.

Asters are especially abundant in North America, whence many of the handsomest species have been taken across the water and grown in European gardens, sufficiently long and successfully to be considered deserving of special names for the resulting varieties. From abroad, many of these have again been returned to this country to be introduced into gardens.

The smooth aster (1) is one of the loveliest of these so-called "starflowers," because of the many slender rays about a golden center and the aggregation of the numerous blue-violet heads in a close panicle. It is not exacting in its requirements and will succeed in good soil in either full sunlight or partial shade.

A late-flowering aster (*A. novi-belgii*) of similar color, is frequent in swampy soil near the Atlantic coast, while in the Far West the common aster (*A. chilensis*) is found in the valleys and foothills of parts of California.

New England Aster

Quebec to S. C.; west to Ala., Colo., and Sask.

The superb clusters of rich rose-purple blossoms of the New England aster (2) should be awarded the prize for stately beauty in the floral pageant from August to October, when they exhibit a profusion of bloom in fence rows or other sunny situations where moisture still lingers. This preference affords a hint that may well be taken into account when transferring to the garden, where but little shade, if any, together with moist soil, will make this plant feel very much at home.

In company with lavender and white asters, and yellow goldenrods, New England asters offer the landscape architect a wealth of material for roadside beautification.

Boltonia

Conn. to Fla.; west to La., Neb., Minn.

For all practical purposes, boltonia (3) may be treated as an aster, though the fruit exhibits one or two technical differences. It is named for an English professor of botany. It is a pretty plant, with smooth leaves and head with rose-pink rays and yellow centers, which may be found in moist places and along streams in the East and Middle West. The plants grow tall and leafy and bear a profusion of bloom in late summer. This makes it of especial value for highway landscaping where unusual moisture is available, since there are few showy species adapted to growing in such situations.

Boltonias are easy of cultivation, and need little care when once well established.

Prairie Coneflower

Minn. to Tex.; west to Ariz., Mont., B. C.

There are three common genera in the aster family that are popularly known as "coneflowers," since all are characterized by unusually well-developed centers to the flower heads. The individual species, however, present distinct differences in the shape and texture of the "cones." The rose coneflower (*Echinacea*, Plate XVII), for instance, has a symmetrically rounded center that is rough and prickly to the touch, while black-eyed Susan (*Rudbeckia*, 5) receives its name from centers that are dark brown, firm and satiny, and the prairie coneflower (*Lepachys*) is distinguished by "cones" that are soft and furry, slender, and sometimes as long as two inches or more (4).

Still another characteristic that marks this species with distinction is to be found in the remarkable ray flowers that are frequently almost as broad as long, and sometimes reach a length of one and a half inches. The color is usually a bright golden yellow, but a handsome variety with a maroon-red splotch at the base of the ray is not uncommon and occasionally the entire ray is similarly colored.

Black-eyed Susan

Ont. to Fla.; west to Tex., Colo., and Manitoba

The "black eyes" of "Susan," which reflect the light with a satin sheen, are the chocolate-brown, firm-textured centers of flower heads with long spreading rays of brightest yellow (5). Groups of these plants with stiff, bristly stems and rough leaves brighten meadows and moister prairies from May to September.

Rudbeckia is the third member of the popular trio of coneflowers, and when its shining gold is associated with the rose purple of *Echinacea,* and the maroon-tinged *Lepachys,* a truly interesting floral combination results. Like these others, it is remarkably easy of cultivation and will thrive in situations that are too hot and dry for less hardy species.

Of those that are more exacting in their water requirements, the tall coneflower (*R. laciniata*) which prefers brook banks when growing wild, will give rise to unusually large and greatly doubled forms in the garden, where it is deservedly popular under the name of "golden glow." Autumn glory and autumn sun are varieties of still another species (*R. nitida*). The former has a longer period of blooming, lasting sometimes until Jack Frost rings down the curtain on the floral parade. Autumn sun, with bright primrose-yellow blooms, may reach a height of six feet and will flower from August to October.

Another coneflower (*R. triloba*) forms dense twiggy bushes about three feet tall and wide, and bears a profusion of heads similar to those of black-eyed Susans, though smaller. The tall coneflower may be poisonous to sheep.

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DAINTY STAR FLOWERS PROVE "SHE LOVES ME" OR "SHE LOVES ME NOT"

Through warm days and frosty nights of autumn, the Aster clan strews fields with matching hues of yellow, violet, and rose purple. The (1) **Smooth Aster,** *Aster laevis,* is content in dry exposed areas, while (2) **New England Aster,** *Aster novae-angliae,* thrives on moist soil. In late summer streamsides are spangled with (3) **Boltonia,** *Boltonia asteroides.* Furry-soft cones and short broad rays identify (4) **Prairie Coneflower,** *Lepachys columnifera.* From May to September, ranks of (5) **Black-eyed Susan,** *Rudbeckia hirta,* toss their gold-and-brown heads.

Stiff Sunflower

Ill. to Ga.; west to Tex., Kan., Minn.

In that season of the year when the great disk of the sun delays its rising and hastens its setting, miniature floral suns blaze in fields, prairies, and along roadsides, where they are popularly believed to turn their faces ever toward the golden orb in the sky above them.

This pretty fancy, however, will not survive in the face of plain truth, for, more often than not, it is the wind that causes the flower heads to turn in the same direction, and though that may often be toward the position that the sun is occupying at the moment, it is not always so.

Sunflowers in general and the common species (*H. annuus*) in particular are not popular with the farmer, who looks with no friendly eye upon this robust adventurer into his fields, for, unless repulsed, it soon takes full possession to the detriment of cultivated crops. Nevertheless, Kansas has selected this species of *Helianthus* as the State flower, and the Incas of Peru exalted it to a high position in their ceremonies of sun worship.

Starting as a modest plant of the plains, the common sunflower has responded to cultivation to such a degree that many varieties of unusual height and size of flower head have been produced, some growing as tall as 12 to 15 feet with heads a foot or more in diameter. The seeds become so large as to be used as an article of food in foreign countries, and as feed for poultry and birds here. In addition, they yield an oil that is an important article of commerce, and the stems yield a fine fiber comparable to silk.

The Jerusalem artichoke (*H. tuberosus*), which is not an artichoke and does not come from Jerusalem, is a sunflower with an edible tuber that was first appreciated by the Indians, and is still extensively cultivated.

Although not commercially valuable, the stiff sunflower (1) offers an attractive addition to the garden. It is remarkably easy to grow and may reach a height of eight feet under favorable conditions.

The flower heads present a pleasing contrast of brown centers and golden rays, much like those of California's bush sunflower (*Encelia californica*), a handsome shrub of the coastal hills.

Rough Oxeye

Maine to N. J.; west to N. M. and British Columbia

Oxeyes (2) are tall, leafy plants bearing numerous attractive bright-orange flower heads that come into bloom in late summer. Although not generally cultivated, they are well suited for the back of borders and deserve greater popularity in home gardens. They might easily pass for sunflowers, except for the fact that the ray flowers, instead of falling back from the head, turn dry and persist as they do in zinnias of the garden.

Tickseed

Pa. and Del.; west to Tex., Kan., Ill.

Tickseeds, sticktights, and beggar-ticks are all names that have been applied to the genus *Bidens,* which means in Latin "two-tooth." All these terms refer to the little flat fruits with two hooked prongs at one end that enable them to catch hold of anything with which they may come in contact, and so get free transportation to other places.

Many species of *Bidens* have insignificant flower heads that may often entirely lack encircling rays; but some, like the one illustrated (3), are quite showy, with large heads and conspicuous bright-yellow rays. As a rule, these are fond of wet places and are found in swamps, ponds, or along the banks of streams. It is probably this liking for water that has prevented their being more generally introduced into gardens in contrast to their close relatives, the dahlia, cosmos, and coreopsis, which are all prime favorites under cultivation.

Golden Coreopsis

Minn. to La.; west to Ariz., Neb., Alberta

With broad rays warmly golden in color and rich crimson in the center, with tall, slender, branching stems and beautifully cut foliage, coreopsis (4) transforms ditch banks or wet places into gardens of loveliness. Although the seeds look much like those of its less popular close relatives, the tickseeds (3), they are not so well provided with hooks and are less likely to travel and become nuisances.

Wavy Thistle

Mich. to Tex.; west to Ariz. and B. C.

The wavy thistle (5) has leaves covered with a dense white wool, and the plants are large and handsome, with flower heads colored a rich rose lavender. A near relative, termed the "yellow-spined thistle," is armed with innumerable long, yellow spines, which qualify it as the prickliest member of the genus. The western thistle (*Cirsium occidentale*) of the Pacific coast wears an unusually deep shade of crimson, and takes possession of sandy soil from Baja California to Oregon.

The name "thistle" has been applied to a variety of plants, but belongs properly only to those members of the aster family that have large heads of tubular florets, typically armed with stiff prickles. For instance, the Russian thistle, far from belonging to the aster family, is a relative of beets and spinach in the family of the "goosefoots."

Neither the Canada thistle (*C. arvense*) nor the Scotch thistle (*Onopordon acanthium*) is a native of the land for which it is named. The former is actually a stowaway immigrant from Europe, and the latter is not even known to grow in Scotland at all! The exact species honored as the Scottish national flower cannot be definitely known, since it was so chosen in the thirteenth century when only traditions and not science were sources of information.

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TALL SUNFLOWERS ARE MINIATURES OF THE SKY'S GLOWING ORB

Brown centers contrast with butter-colored rays of (1) **Stiff Sunflower,** *Helianthus rigidus,* which may grow eight feet high. Tall and handsome (2) **Rough Oxeye,** *Heliopsis scabra,* forms a bright background for the garden. Pronged "hitchhiking" seeds, which catch on anything that brushes by, name (3) **Tickseed,** *Bidens involucrata.* Relatives are (4) **Golden Coreopsis,** *Coreopsis tinctoria,* and (5) **Wavy Thistle,** *Cirsium undulatum,* with woolly stems and leaves.

SPIDERWORT FAMILY

(*Commelinaceae*)

Spiderworts belong to that division of the plant kingdom called "monocotyledons," since the tiny plant as it bursts from the seed has but one seed leaf instead of two. Later, when the mature leaves appear, they are frequently long and narrow like grass leaves, or, if broader, can be distinguished by the veins which run parallel to each other instead of forming networks or branching freely as they do in most plant families. The flowers of spiderworts have three green sepals and usually three brightly colored petals that last only a short time after the bud opens.

There are but few spiderworts at home outside of the Tropics, but many of them may be grown in the garden in any rich, light soil.

Spiderwort

N. Y. to N. C.; west to Ark., Kan., Minn.

The spiderworts are exquisitely fragile blossoms, lovely with tints of rose color or lavender blue (1). When the spring and early summer seasons are warm and moist, the slender-leaved plants may thrive to such a point that railway embankments or prairies and meadows of the Middle West become spectacular with bloom. The beauty is fleeting, however, for as the temperature rises toward midmorning, the petals wilt and the buds await the coolness of another day.

The most important spiderwort under cultivation is called the "wandering Jew" (*T. tricolor*), since the trailing stems grow to great lengths and wander in all directions.

Dayflower

N. Y. to Fla.; west to Tex. and Kan.

Dayflowers (2) are the progressive members of the spiderwort family, for they have seen fit to enlarge two of the petals at the expense of the third, so that a casual glance gives the impression that there are but two. These, however, are a blue of such purity and intensity that it cannot be matched by any color on the artist's palette. The other parts of the flower have also taken on an unusual appearance that makes it easy to distinguish them.

LILY FAMILY

(*Liliaceae*)

Apparently the true lilies have found that their device for attracting insects, by means of having the six parts of the perianth brightly colored instead of leaving the three sepals green as the dayflowers have done, has been an enormous advantage in the struggle for existence, for they constitute a very large family spread all over the world except the Arctic zone. Moreover, among them may be found some of the most beautiful flowers in existence anywhere, of which tulips, hyacinths, day lilies, spring lilies, and mariposa lilies are known to every flower lover.

Red Lily

Maine to N. C.; west to S. D. and Manitoba

In the moister climate of the eastern part of the country red lilies (3) take to the woods and thickets, but in the Middle West or the Rocky Mountains of Colorado they prefer brook banks and wet meadows. These handsome plants are tall and stately, with large blossoms of brilliant vermilion at the ends of stiff stems with whorls of narrow leaves.

That few gardens exhibit any of the many lovely species available for cultivation may be due to a mistaken notion that lilies are difficult subjects. It is true that some require a close imitation of their native habitats to thrive, but others, with beautiful flowers suitable for cutting, are remarkably easy to grow.

Yellow Lily

Nova Scotia to Ga.; west to Ala., Neb., Minn.

This beautiful golden-yellow lily (4), decorated with maroon spots, is nowhere especially abundant, but may be found in swamps, meadows, and fields throughout the eastern half of the country where varieties with red flowers or recurved perianths also occur. The Turk's-cap lily (*L. superbum*), and the Canada lily (*L. canadense*), with orange or orange-red blossoms, are perhaps more strictly eastern, while the stately plants of the western yellow lily (*L. parryi*) seek moisture on the middle slopes of the mountains in southern California and bear huge flowers of pale yellow.

Pink Onion

Colo. to Ariz.; west to Calif. and B. C.

To many who are accustomed to thinking of onions only in terms of the leafy bulb which appears in the kitchen or on the table as a vegetable of special flavor or quality, it may never have occurred that there are also onion flowers. Not only do onion plants produce blossoms as well as stems and leaves, but they are often daintily attractive or brilliantly colored, and, since they usually occur in clusters, may also be effectively ornamental.

This pink onion (5) has small flowers of rose lavender, loosely clustered at the ends of rather stiff but slender stems, and is fond of prairie sites as well as the lower slopes of the Rocky Mountains. The different flowers in a single group open successively from the outside toward the center, so that at any stage there may be capsules enclosed in papery calyxes ripening on down-bent stalks, full-blown blossoms making up most of the cluster and unopened buds pushing up in the center.

In middle-western hills and mountains the nodding onion (*A. cernuum*) is so named because of the pendent position of the blossoms, a lovely rose pink. The purplish field onion (*A. vineale*) of eastern fields and meadows is a European emigrant that repays naturalization in this country by infesting pastures and tainting the flavor of butter in spring.

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STATELY LILIES BASK IN MIDDAY SUN THAT WILTS FRAGILE SPIDERWORTS

On cool spring mornings the prairies display masses of fragile blooms of (1) **Spiderwort,** *Tradescantia virginiana.* When the sun soars high, their petals wilt. Another exquisite Spiderwort, (2) **Dayflower,** *Commelina erecta,* blossoms in late summer and early autumn. Members of the Lily legions are (3) **Red Lily,** *Lilium philadelphicum,* with brilliant upturned "goblet," (4) **Yellow Lily,** *Lilium canadense,* which modestly hangs its "head," and dainty (5) **Pink Onion,** *Allium acuminatum.*

Bellwort

Quebec to Fla.; west to Miss., S. D., Manitoba

Graceful bellwort plants (1) with delicate green leaves grow side by side with violets, spring lilies, wake-robins, and Dutchman's-breeches in moist woodlands of the eastern half of the country, as well as in similar situations as far west as Minnesota and Kansas. During May and June they put forth pale-yellow blossoms that are faintly fragrant and hang bell-like on slender stems. They are charming rather than showy, and although not as yet known to home gardens they are hardy and easy to cultivate in a light rich soil in the shade.

Two other species of bellwort, much like the one illustrated, are to be found similarly in rich, deciduous woods over a wide region, from Minnesota to eastern Canada and southward to Georgia and Arkansas. Of these, the so-called "large-flowered bellwort" (*U. grandiflora*) is little more than a somewhat larger edition, while the "sessile-leaved bellwort" (*U. sessilifolia*) is thus awkwardly named because of leaves that touch the stem without closing around it. In spite of the larger flowers borne singly, bellworts are not-so-distant relatives of the commoner and better-known true and false Solomon's-seal.

White Adder's-Tongue

Ontario to Ga.; west to Tex. and Minn.

Adder's-tongues are also popularly known as "dogtooth violets" or "spring lilies," although they are not true lilies of the genus *Lilium,* and certainly are not in any respect violets. The scientific name of the genus, *Erythronium,* is derived from a Greek word meaning "red" and may refer to the red mottlings on the foliage of some species. These markings are faintly visible on the pair of pretty grayish-green leaves of the adder's-tongue illustrated (2), between which springs a slender, graceful stem bearing a single drooping white blossom delicately flushed with rose color. This species is found occasionally in the East, but not so frequently as in the West and South, where it blooms from March to May.

The white adder's-tongue possesses an interesting and unique habit that is also characteristic of some other woodland species. By means of contractile roots on the solid bulb or "corm," this underground part is pulled gradually downward in the soft-yielding leaf mold of the forest. Each year the corm sends up a single leaf until eight or ten years have passed, when two leaves appear and the flower unfolds between them. In consequence, there may be seen in any favorable situation thousands of one-leaved plants to one that bears a flower.

Yellow Adder's-Tongue

Nova Scotia to Fla.; west to Ark. and Minn.

The yellow adder's-tongue (3) resembles the white species (2) in having a slender, pink-tinged stem with a nodding blossom at the tip, and in having leaves mottled with crimson. It differs in color of flower and in the attachment of the pair of leaves, so much lower on the stem that they appear to be basal. The one excels in delicate charm, the other in a more colorful beauty; both are partial to the cool moisture and shade of spring woodlands or thickets and will grow equally well in similar conditions under cultivation.

Another similarity is to be found in the presence of contractile roots which draw the corm downward through the leaf mold from year to year for a number of years.

This habit seems to be conditioned, in part at least, by the character of forest soil, for where erythroniums grow in the firmer soil of the prairies, or volcanic ash, two-leaved flowering plants are the rule and not the exception. In consequence, a favorable spring will see the slopes of Mount Rainier carpeted by thousands of plants of the yellow glacier lily (*E. parviflorum*) and the white avalanche lily (*E. montanum*), with flowers in such abundance that the leaves can scarcely be seen for the myriads of bright blossoms nodding above.

Snowy Wake-Robin

Pa. to Ky.; west to S. D. and Neb.

Trilliums differ from their numerous lily kinfolk in having a green calyx, such as is found in the spiderwort. In consequence, they are to be regarded as the lowliest of the lilies in spite of the beauty of the flowers, since these have not taken the step of coloring the sepals to match the bright petals.

The Latin name, *Trillium,* refers to the fact that all parts of the plant occur in threes: sepals, petals, styles, and leaves.

The interesting common name of "wake-robin" alludes to the early appearance of the blossom in spring, so early it seems even to precede the robin, one of the earliest birds.

The lovely white-flowered species illustrated (4), with a snowy expanse of petals against a background of dark-green leaves, is one of the earliest to bloom in woods and thickets of the East and Middle West, together with bellworts, adder's-tongues, and Dutchman's-breeches.

Nodding Wake-Robin

Newfoundland to Ga.; west to Mo., N. D., and Manitoba

A decided contrast to the snowy wake-robin, this trillium (5) is dark wine red, with a calyx of narrow pointed sepals and three very large broad leaves a few inches below the flower, which hangs on a slender stem. It blooms somewhat later in the spring in moist woods, together with the purple trillium (*T. sessile*) which has a much larger rose-purple blossom borne upright without a stalk. This beautiful wake-robin also grows in the Far West in woodlands of California and northward.

Trilliums, erythroniums, and bellworts are all reputed to possess roots which are violently emetic if the drug derived from them is taken internally, but which may also be found soothing in the form of poultices for swellings.

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FAVORITES AMONG "THE FLOWERS THAT BLOOM IN THE SPRING"

During May and June moist woodlands are dotted with pale-yellow blossoms of (1) **Bellwort,** *Uvularia perfoliata.* Cool shady groves and thickets are the abode of (2) **White Adder's-Tongue,** *Erythronium albidum,* and (3) **Yellow Adder's-Tongue,** *Erythronium americanum,* both popularly known as "dogtooth violets" or "spring lilies." Other Lilies are (4) **Snowy Wake-Robin,** *Trillium nivale,* and (5) **Nodding Wake-Robin,** *Trillium cernuum,* so named because they sometimes bloom before the robins arrive in spring.

AMARYLLIS FAMILY
(*Amaryllidaceae*)

The amaryllis family stands midway between lilies and irises in development, retaining the six stamens of the one and acquiring the inferior ovary, which is one of the main steps of advance from lilies to irises. With such ancestors as the lilies, it is no marvel that amaryllises possess an equal or even greater degree of beauty. The best known are snowdrops, snowflakes, tuberoses, jonquils, daffodils, and spider lilies. Some furnish delectable perfumes and others drugs, poisons, alcoholic drinks, or food.

Yellow Star Grass

Maine to Fla.; west to Tex. and Sask.

The bright-yellow starry blossoms (1) of this little dweller in prairies and meadows bloom inconspicuously on small plants with grasslike leaves. A demure and modest little plant, it is of no value except to add interest and variety to half-shady places in the rockery or border of the garden.

IRIS FAMILY
(*Iridaceae*)

This family ranks high in providing many of the most beautiful and interesting flowers known either in nature or under cultivation. The genus *Iris* alone presents an almost endless variety in form, color, and size, and new ones are being developed constantly by professional horticulturalists. Other remarkably beautiful and well-known members of the family are the gladiolus, freesia, crocus, and watsonia.

Blue-eyed Grass

Newfoundland to Va.; west to Colo. and B. C.

The blue-eyed grass (2) may have leaves that resemble those of grasses somewhat, but the dark purple-blue, six-pointed blossoms with perianth attached to the top of a little round ovary are known by this structure to belong to the family of irises and not grasses.

The flowers are short-lived, but so abundant on vigorous plants that each new day sees many buds opening and revealing to insect visitors by a yellow spot at the base of each petal the exact location of the nectar gland.

Iris

Newfoundland to Fla.; west to Tex., Neb., Manitoba

This species (3), sometimes called the "blue-flag iris," invades marshes and wet meadows in the East and Middle West with stiff-leaved plants crowded closely together and producing an abundance of indigo-blue, tightly rolled buds which unfurl into "flags" of lavender. The broad landing platforms of the down-curving petals are prettily ornamented with a splash of yellow which adds to the beauty of the blossom and at the same time serves to guide bumblebees to the nectar farther back.

ORCHID FAMILY
(*Orchidaceae*)

The orchid family represents the highest development in specialization of the flower for insect attraction and in the perfection of devices for bringing about cross-pollination. Oddly, however, instead of this resulting in a small number of sturdy seeds certain to germinate and carry on into the next generation, which is the usual consequence of unfailing fertilization, it seems to have been followed by the contrary effect. The seeds are so tiny that there may be as many as a million in one capsule, and the method of germinating them and of coaxing the seedlings to grow into mature plants is one of the most painstaking and difficult known, and may take a number of years to bring to full accomplishment.

In nature the many orchids that inhabit tropical forests, where heat and moisture are superabundant, often grow attached to tree-trunks by adventitious roots; in the temperate portions of the Northern Hemisphere they spring from the earth. Wherever they may be, however, their blossoms are remarkable for the curious and varied shapes of the perianth, which may resemble all sorts of queer objects or animals from slippers to beetles or even monkeys.

In size they may vary from the tiniest of white orchids, looking like pearls strung on the stem and only an eighth of an inch across, to those that measure six to eight inches and are incredibly gorgeous in coloring. Only a few are of use to man, and of these the vanilla is the most important.

Coral-Root

Nova Scotia to Fla.; west to Calif. and Alaska

The coral-root (4) belongs to the strange group of plants known as saprophytes or parasites, which manage to survive by stealing from the neighbors instead of making an honest living by manufacturing their own food. The plants are never fresh and green, but take on pale tints of white or cream color, rose purple like the coral-root, or even such fiery, translucent red in the snow plant (*Sarcodes*) that no paint can match it.

Showy Orchid

New Brunswick to Ga.; west to Minn. and Kan.

Delicate and dainty rather than strikingly handsome, the showy orchid (5) produces small clusters of pale-lavender blossoms on a stalk between two large leaves. From April to June showy orchids must be sought in rich woods of the East and Middle West, since they are too difficult for cultivation at home.

Purple Fringed Orchid

Newfoundland to N. C.; west to Neb. and Manitoba

The purple fringed orchid is most at home in meadows, swamps, and wet woods in the north-central and southeastern parts of the country,

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WILD BEAUTIES OF THREE FAMILIES MAKE GARDEN BORDERS GAY

Starry blossoms of (1) **Yellow Star Grass,** *Hypoxis hirsuta,* represent the Amaryllis clan. Two charming members of the Iris family are the dainty but vigorous (2) **Blue-eyed Grass,** *Sisyrinchium angustifolium,* and (3) *Iris versicolor,* the common "blue flag" of meadows and marshes. Among the Orchids are (4) **Coral-Root,** *Corallorrhiza multiflora,* which sprouts from decaying leaf mold, the delicate (5) **Showy Orchid,** *Orchis spectabilis,* and (6) **Purple Fringed Orchid,** *Habenaria psycodes,* with spurred and fluted blossoms.

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TO POLLEN-BEARING INSECTS, ORCHIDS OFFER POUCHLIKE "LANDING FIELDS"

Among the rarest and loveliest of our native Orchids is (1) **Fairy Slipper,** *Calypso borealis,* which hides in deep woods and bogs. The handsome (2) **Moccasin Flower,** *Cypripedium acaule,* flourishes when transplanted to the garden. Large and relatively sturdy and abundant are (3) **Showy Lady-slipper,** *Cypripedium reginae,* and (4) **Yellow Ladyslipper,** *Cypripedium pubescens.* Like all wild species of this group, the (5) **Grass-Pink Orchid,** *Limodorum tuberosum,* requires plenty of moisture.

Fairy Slipper

Labrador to Maine; west to Mich., Colo., Calif., Alaska

The fairy slipper (1) is named for the Greek goddess Calypso, who was not only beautiful but had a reputation for keeping her affairs concealed from the public eye. Her namesake in the flower kingdom is equally famed for beauty and for secretiveness, since it hides shyly away in deep woods and bogs where only diligent seeking will find it.

In shady spruce woods in the Rocky Mountains it is the earliest harbinger of spring, to appear in troops of several score when the season is favorable, or to be represented in the years to follow only by a lonely straggler here and there. This alternation of abundance with scarcity may be conditioned by the need for replenishing stores of nourishment depleted by excess of blooming.

Moccasin Flower

Newfoundland to N. C.; west to Tex., Minn., Manitoba

Orchids are so generally supposed to be rare and fragile that it may come as a surprise to some to realize that many are quite hardy enough to be grown readily in the garden if care is taken to meet their requirements of cool moisture and somewhat acid soil. Rare they are, of course, especially in comparison with other flowers, but this is partly because they prefer bogs and swamps, which, taken all together, make up but a relatively small area of the country at large.

This remarkably handsome moccasin flower (2) with large rose-purple lower lip and brightly colored sepals is at home in boggy woods of the North and East, as well as in sections of the Middle West. It will bring a quick reward to the home gardener in an abundance of fragrant bloom, if grown under conditions of soil and moisture to which it is accustomed in its native haunts.

The business of pollinating an orchid flower presents certain problems to visiting insects, for the smaller ones may fall into the open pouch and be unable to find their way out again. Larger bees alight on the lip in such a way that the head touches the sticky anthers; the pollen mass is transferred to it and so carried to the ripe stigma of another blossom.

If the lip happens to be "irritable," as is sometimes the case, it is set in motion by the impact of the insect and rises to a position which forces the visitor into contact with the pollen, which is then carried to another flower. There are also other devices in the way of guidelines or fragrance that are of advantage, first in attracting pollinators, and then in making sure that they do the work for which the flower is devised. However, although the method of cross-pollination in vogue among the orchids is one of the most successful known, it seems after all of little importance in the life history of the flower, since propagation is more often accomplished by means of bulbs than by seeds.

Showy Ladyslipper

Newfoundland to Ga.; west to Kan. and Manitoba

The flowers of the ladyslipper are the largest and most beautiful of our native orchids, though far outshone by the magnificent cattleyas and laelias of the Tropics that adorn the florists' shops. They are distinctive but not entirely unique in the possession of a sac or slipperlike lip, which may be less than half an inch long, a veritable slipper of Cinderella, in some of the small-flowered species, or an inch and a half in the moccasin flower (2) or the showy ladyslipper (3).

The latter has large blossoms with inflated lower lip variously tinted with rose purple, and broad white sepals. It is one of the most attractive wild orchids in this country, where it grows with other bog plants in swamps and blooms from June to September. It is fairly simple to grow the bulbs in partly shaded moist spots in the garden.

Yellow Ladyslipper

Nova Scotia to Ga.; west to Neb. and Manitoba

This charming orchid (4) adorns its "slipper" of gold with flaring, twisted "ribbons" of yellowish green splashed and streaked with crimson. It is one of the most widespread and abundant of the native ladyslippers, being found in nearly all parts of the country where there are woods and thickets with leafy mold to suit its preferences. In such a large group of plants so widely separated, however, local differences occur that have been considered by botanists to be deserving of distinctive names.

The yellow ladyslipper *C. parviflorum,* occasionally found in the forests of the West and Northwest, has smaller flowers than those of this yellow ladyslipper, which is more closely restricted to the East and Middle West. Since size is often associated with soil moisture, however, this distinction seems unimportant.

Since gathering plants that spring from bulbs tends toward their eventual extermination, the better way is to enjoy their beauty where found, or to transplant carefully to the garden. Yellow ladyslippers are hardy and will grow in cool, moist leafy mold or rockeries. There seems to be evidence, however, that the hairs on the plants irritate the skin of some individuals, much as poison ivy does.

Grass-Pink Orchid

Newfoundland to Fla.; west to Mo. and Minn.

The pale pink, butterflylike blossoms of this orchid (5) bloom in quick succession along slender stems with grasslike leaves, and although the plants are not common they may be found in favorable habitats in the Middle West, as well as in bogs and wet meadows of northern and eastern States.

WHAT IS IT? BIRD, MAMMAL, OR REPTILE?

One of the strangest creatures on earth is the little duckbill platypus. It has a birdlike bill, webbed feet with horny claws, and fur and tail suggesting a beaver's. This primitive mammal, like many reptiles, lays eggs.

Photographs by Morwell Hodges

HIGH-STRUNG "PLATTER-PUSS" GOES FORAGING

Found only in Australia and Tasmania, the semiaquatic platypus is extremely shy and wary.

AUSTRALIA'S PATCHWORK CREATURE, THE PLATYPUS

Man Succeeds in Making Friends with This Duck-billed, Fur-coated Paradox which Lays Eggs and Suckles Its Young

By Charles H. Holmes

HIGH on the Australian Alps the winter's snow is melting. The mountain streams are full-flowing and after dusk ripples on the water denote life. Old Man Platypus, who lives a semiaquatic existence, commences his nightly outing for fun and food.

His duck bill, soft as a piece of kid and pliable as rubber, cuts the water like the prow of a boat, front webbed feet giving powerful propulsion to his body, which is furred to the eyes. His back feet are webbed, too, but, for reasons best known to himself, the platypus merely trails his rear extremities.

This time of the year his mate is likely to be in a nest of grass and gum leaves at the end of a twenty- or thirty-foot tunnel in the bank, hatching her eggs. If that be her occupation, the female platypus will have sealed herself in the tunnel for three weeks and will have built up two or three earth plugs about a foot in thickness.

And so the platypus furrowing the placid waters of the mountain stream may be a disconsolate outcast, just mooching about catching tadpoles or shrimps or the juicy white wood grubs that sometimes fall from the wattles lining the river bank (page 277). Or maybe the wandering male is courting other duck-billed folk of the egg-laying variety.

MALE WEARS POISON SPURS

Early colonists in Australia made the acquaintance of the platypus, and what a paradox it proved: a duck's bill; a fur coat instead of feathers; four webbed feet instead of two; poison spurs on the hind legs of the male; the female laying and hatching eggs and suckling the young.

An impossible patchwork creature it seemed, equally at home in the water or on the land, boasting something of fish, fowl, beast, and reptile and richly deserving the name it was given at first, *Ornithorhynchus paradoxus,* or bird-bill paradox.

Naturally the amazed colonists sent a skin to the British Museum. One of its naturalists fingered the rich fur with the broad bill unbelievingly, and was inspired to suggest at first that the bill of a duck had actually been grafted onto the skin of a quadruped! (Page 278).

The world wondered and scientists in various countries sought living specimens, but received them dead.

Out of five of the creatures netted in their mountain stream in 1922 and dispatched across the Pacific to the New York Zoological Park, only one survived and then for merely a matter of weeks.

ONE OF THE WORLD'S TWO MOST PRIMITIVE MAMMALS

The lonely platypus which reached New York was placed in a specially prepared tank and artificial burrow, where it excited great interest, for the platypus and the echidna, which also is an egg-laying animal, are the most primitive of all living mammals in the world today. As types, they should have disappeared from the earth millions of years ago, but through time's forgetfulness they remain as living reminders of their reptilian ancestors.

In the New York zoo, the platypus which survived ate heartily. In fact, it ate nearly half its own weight in shrimps every 24 hours. But no living creature had ever been forced to endure such a fierce floodlight of publicity and at the end of 47 days the shy animal felt it had suffered man too long; *Ornithorhynchus anatinus* closed its bloodshot, beady little eyes and, in dying, received even greater publicity.

Today no platypus can be exported alive from continental Australia and the law is most stringent. You cannot touch the wonder animal. If you are found in possession of a platypus, dead or alive, or even of a skin, it means a big fine. In earlier days many a rug made from dozens of platypus skins fetched high prices in other lands, for the fur is thick and beautiful.

Photograph by Morwell Hodges

"HOW'S THIS FOR A DUCKY POSE?"

Soft as a piece of kid and pliable as rubber, the platypus's flat bill is used for separating food from waste. While diving, the slits containing eyes and ears are tightly shut to keep out sediment.

Rare indeed is a glimpse of a platypus in the wild, but on a fishing trip in the Alp country of Victoria I once saw four at a time.

After a splendid day's sport we were squatting on the river bank, swapping experiences and bragging about the fish we had caught in previous seasons.

Suddenly someone swore he saw a platypus run down the opposite bank and dive into the water. We sat concealed on the bank hoping to see more of them. Our pipes went out. We suffered cramp and were annoyed by leeches.

At last a few dots appeared on the water, floating without movement. Having apparently decided that the coast was clear, four platypuses began to race about after food, now furrowing their way on the surface, snapping up tidbits with a side-to-side wobble of the bill, now submerged. We watched for nearly an hour, but they never came near the bank.

A slight sound and four dots disappeared in a flash. The shy creatures had lived up to their reputation and I despaired of ever seeing a platypus at close quarters.

But something happened which made it possible to observe this strange animal on intimate terms. An Australian, Robert Eadie (page 277), returned to his homeland after spending many years in South Africa and became absorbed in a young platypus caught on the bank of a stream near his home in the hill country of Healesville, Victoria.

"SPLASH," THE PLAYFUL PLATYPUS

With official permission, Eadie succeeded in taming a platypus, and it lived in captivity for more than four years. He kept it in a specially constructed box tank and covered retreat, and month after month he closely studied his small protégé.

When Eadie trailed worms along the surface, the platypus chased and snapped at them, jumping half out of the water. Eadie discovered that it loved to play, and soon an old mop, drawn about in the tank, sent the platypus mad with delight (page 280). It raced after the mop, grabbed it in its bill, and gripped it with its spurs.

This became a daily game, Eadie lifting the mop out of the water several feet with Ornithorhynchus more or less wrapped around it. Then the platypus let go and flopped into the water. A dozen times or so the operation was repeated, for "Splash," as the wonder creature was named, loved that flop into the water.

Splash's sleekness bespoke 150 tadpoles and about twelve ounces of worms daily,

Photograph by Morwell Hodges

FOR STROLLING ON THE BEACH, SKIN WEBS ON FORELEGS FOLD UNDER

The platypus is usually active at night, playing and feeding in streams or ponds. Bright light nearly blinds it. When swimming in the daytime, it often bumps awkwardly into obstructions.

plus, if you please, two duck eggs slightly cooked and scrambled. He loved his "tummy" in another way, for he rolled over on his back in the water so that the mop could be rubbed on his stomach.

Through the medium of the mop and the tadpoles, Splash got a lot of exercise. The tadpoles were run down in the tank by the excited hunter with not a little professional pride. Sometimes a hundred were put into the pool at one time and the voracious Splash wolfed the lot in short order.

AT MEALTIME SPLASH CAME RUNNING

At feeding time Eadie would whistle and Splash would run out expectantly from his retreat at the magic sound, wondering, no doubt, whether it would be tadpoles, grubs, worms, or duck eggs.

So far as the egg diet is concerned, therein lies a tale. Eadie came home one afternoon and surprised Mrs. Eadie at the pool with the furtive look of a small child detected "in the act." When questioned, she replied that she felt sure Splash was hungry and had given him some egg.

"My goodness, the creature will die, mother," exclaimed Eadie, greatly alarmed.

"Don't you worry, Robert," was the reply, "the wee creature liked the egg, even better than the worms!"

And "mother" was right, for, thereafter, throughout his life, Splash had two eggs every night, beaten up and placed in a vessel of boiling water until the mixture boiled up like milk. It was then let gently into the water, the platypus climbing into the bowl to consume the egg (page 279).

Eadie's first experiment with a platypus was in the Badger Creek Sanctuary at Healesville, where he built an enclosure about thirty feet in diameter surrounding a domed island about six feet high. Complete with artificial burrows and an underwater entrance, and with a mountain creek diverted to flow all around it, this sanctuary rejoiced in the name of "Platypussary." Here the first platypus lived 182 days.

Eadie then installed the second platypus, Splash, in his garden where he could watch over it constantly. Special quarters were built, modeled on the lines of the animal's natural surroundings.

"Burrows" led from a shallow concrete tank to the nesting box and to a turfed area about nine feet square where the platypus did a lot of scratching and burrowing at night. This kept his claws from growing too long and gave exercise.

Burrowing out from the scratching area was prevented by wire netting placed in the ground a few inches below the surface.

Photograph by W. Howieson

MELTING SNOWS OF THE AUSTRALIAN ALPS FEED STREAMS THE PLATYPUS FREQUENTS

From a fenced lookout point (extreme right), spectators gaze down on the mountain-hemmed valleys where lives the duckbill. Sheep raising is an important activity in this district in the States of Victoria and New South Wales.

WHERE FRAGRANT WATTLES SHOWER THEIR GOLDEN BLOOMS

Along the reedy margins of clear, cool streams the platypus feeds. In the earth banks the female digs her nesting burrow, which may be as much as 60 feet long, with its entrance usually just above water level.

Photographs by W. Howieson

MR. ROBERT EADIE, DUCKBILL-KEEPER EXTRAORDINARY

In a tank at Healesville, Victoria, this gentleman kept Splash, a pet platypus, for a record period of more than four years. Two fine specimens now are flourishing in his unique "platypussary."

Photograph by Morwell Hodges

AT FIRST GLANCE, SCIENTISTS THOUGHT, "THERE'S NO SUCH ANIMAL"

When shown this creature of contradictions, some naturalists were deceived into thinking the bill of a duck had been grafted on the skin of a mammal. Gripped in a man's hand, Splash angrily waves webbed flippers.

Photograph from Australian Institute of Anatomy

IN AN UNCOVERED NEST, TINY TRIPLETS LIE CURLED IN SLEEP

The female platypus lays her eggs (usually two) in a reed- and root-lined cavity at the end of the nesting burrow. On her smooth tail they are clasped against the body. Newly hatched young are less than an inch long. The mother's milk is supplied through perforations in the abdominal skin (page 281).

Photograph by Morwell Hodges

BASKING IN THE SUN IS SAFER NOW THAT THE LAW PROTECTS HIM

Formerly rugs were made from beautiful rich-brown and grayish-white furs of the platypus. Export of the animal is now forbidden and a heavy fine is imposed for possessing one, dead or alive, without permission.

Photograph by W. Howieson

SPLASH MUNCHES HIS EVENING MEAL OF SCRAMBLED DUCK EGGS

The wild duckbill lives on aquatic insects, crustaceans, tadpoles, grubs, and worms. Mr. Eadie supplemented this diet with two duck eggs which were slightly cooked and lowered into a submerged bowl. The pet ate about a third of his own weight a day (pages 275 and 282).

Photograph by Morwell Hodges

PLAYTIME IN THE "PLATYPUSSARY"

Mr. Eadie exercised Splash with a small mop which drove the little animal mad with delight. When the "teaser" was lifted several feet above the water, he would cling to it, then drop with a resounding plop. Hind legs of the males are equipped with hollow spurs. Glands supply them with poison, which can be ejected in real combat. A burrow entrance has been cut in the boards of the tank side (page 274).

Photograph by W. Robert Moore

UNDER WATER, THE DUCKBILL CAN HOLD HIS BREATH FOR FIVE MINUTES

He uses the dog-paddle technique when swimming, propelling himself chiefly with his front legs. Hind ones usually trail under the broad tail.

The water was changed every morning and the whole tank hosed out, for the platypus must have clean water.

Splash was captured on Saturday, February 11, 1933, and died in 1937. Eadie has had two others for the past year.

FISHERMAN POISONED BY PLATYPUS

The hollow spur on each hind leg of the male platypus is connected to a gland secreting a rather virulent poison. At Healesville a case was recalled in which a platypus spurred a strong, healthy man. He was fishing one night and the platypus took the bait. When the fisherman tried to take the animal off the hook, the spurs were jabbed into his arm from both sides.

The arm swelled up to twice its normal size; one side of the man's body swelled and his temperature became very high. All the symptoms of snake venom were present and it was about seven days before the man recovered.

The bill of the platypus, soft as a piece of kid, is one of the most sensitive organs known, since it is used in lieu of eyes in hunting food. When the platypus dives, he draws a flap of skin over eyes and ears and seeks his food with a right and left swinging motion of the head as he goes through the water (page 274).

The vision of the platypus is so directed that it sees little or nothing straight in front. It looks up at an angle, this fact probably indicating that it has always had to look upward to be on guard against enemies. The animal will swim right into any object in the water. In the rivers, it comes up to breathe every few minutes; it does this silently, hardly disturbing the water.

One platypus I saw on land moved with great rapidity despite its short, stumpy limbs. When fully grown, the platypus is about two feet in length, of which about six inches is tail. Its hearing is acute.

The young platypus nuzzles at the breast of the mother, stimulating the milk glands so that the milk is ejected through the perforated skin and can be licked up by the young. Afterward there is no sign on the animal whatever to indicate where the liquid was ejected.

Early stages of keeping the platypus are extremely difficult because its nervous system is so highly organized that specimens have been known to die in the hands of their captor when taken out of the river.

The difficulty is to induce the platypus

to take food. Splash took no food for 11 days and 11 nights, then began eating his master out of house and home. Despite his 11-day fast, he was still alert and active, indicating a reserve of food in the form of fat. During the first month he was badly frightened, but he gradually became entirely friendly.

EATS DAILY A THIRD OF ITS WEIGHT

Supplying enough food is a real problem in keeping the platypus, since it is fed twelve ounces of worms and grubs daily; that is, it eats about a third of its own weight each day. The latest addition to the sanctuary is a "wormery" consisting of manure plots covered with sacks, and if more of these creatures are placed on show, one can readily imagine an appeal to visitors to bring worms and grubs. Even at present, Eadie receives supplies of them from places many miles distant where woodcutters and others, who have heard of friendly little Ornithorhynchus, remember its voracious appetite.

When the supply of worms was difficult to maintain as the drier weather came on, substitutes were tried. Meat of all descriptions, liver, sheep's brains, fish large and small, were offered, but the platypus would not touch them. The liver and other meat were cut in strips to resemble worms and mixed with them, but the platypus tossed them aside with his bill.

He wouldn't touch shellback snails; he wouldn't touch frogs—two were put into the tank and left there, but were not eaten. He would eat freshwater prawns, but apparently was not fond of them. He wouldn't eat vegetable matter, grass, or roots, but would swallow beetle larvae found in the water.

The platypus has no teeth and cannot eat anything with tough tissue. This explains why meats are not eaten and also suggests that the framework of frogs prevents the platypus from eating them.

He will not overeat; he leaves any surplus. His food is all brought up to the surface of the water, in cheek pouches, where it is "chewed" with the water going in and out of his bill all the time. Dirt is always fed with the worms, as it has been found by scientists that there is always a quantity of dirt in the stomach of any platypus examined. It seems not to interfere with the digestion of food.

One day the platypus did not come out of his box at the usual time and was found curled up in a corner, apparently in a dying condition. When handled and placed on the ground, he simply rolled onto his back. Then he was placed in the water and soon bubbles of air floated to the surface, indicating that he was drowning.

Thereupon, for no particular reason except that the day was cold, the platypus was placed in his box in front of a fire, and in a few minutes he was trying to get out, as lively as ever.

About a week later the same thing occurred. He was not disturbed and he remained for three days and three nights before coming out and going for his food as usual.

Another fortnight elapsed and the same thing happened again, the platypus remaining dormant from Monday evening until Saturday afternoon. He came out as bright as he could possibly be, indicating that his sleeping periods were merely a form of hibernation.

STRANGE CLUCKS AND HISSES

When a dog snuffled around the box and even, on occasions, when people were standing too near, the platypus made a growling noise somewhat after the style of a broody hen, a sort of clucking. He was also noticed occasionally to make a kind of hiss, like a gander, and sometimes, but not frequently, a little fluid was ejected from the bill.

When in the pool, Splash was on the move all the time, and was not a bit frightened even though as many as ten people might be gathered around the box, talking and laughing as they looked on. When Eadie whistled and held a handful of worms near the water, the platypus turned and, with his front legs paddling rapidly, hurried along, almost standing on the tip of his tail in his endeavor to reach the worms. His webbed feet beat the water in a flurry to help him maintain the upright position. The bill opened and shut in the same quick way as that of a duck collecting its food out of a muddy pool.

Thousands of visitors have traveled to Healesville, about 40 miles from Melbourne, to make the acquaintance of Splash and his successors. Thanks to Robert Eadie, man is steadily gaining a greater knowledge of one of the world's strangest and shyest animals, the living fossil, *Ornithorhynchus anatinus*, and who knows but that the next few years may see this paradox of Nature happily established in the zoos of the world.

VOL. LXXVI, No. 3 WASHINGTON SEPTEMBER, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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RIO PANORAMA

Breath-taking Is This Fantastic City amid Peaks, Palms, and Sea, and in Carnival Time It Moves to the Rhythm of Music

BY W. ROBERT MOORE

With Illustrations from Photographs by the Author

THE River of January proved a myth. André Gonçalves—if indeed it was he, as most historians now believe—was wrong. The vast reach of water on the newly discovered Brazilian coast, into which he sailed on New Year's Day, 1502, and which he named Rio de Janeiro, was not the mouth of a mighty river, but a bay.

No myth is Rio de Janeiro, gigantic Brazil's gay capital, which has grown on the western shores of this bay. But it almost seemed so to us when, the twelfth morning out of New York, the throb of the propellers of our Good Neighbor Ship, the *S. S. Uruguay,* slowed down for the first time.

INCREDIBLE CRAGS FOR SKYSCRAPERS

Straight into the midst of incredible mountain crags we steered. Mists and fog so distorted the perspective that they appeared like the paintings of some ancient Chinese master who had piled peak upon peak to portray his bizarre Garden of the Gods. Rio *couldn't* be here, but it was!

Morning breezes soon blew away the mists, but not Rio's unreality. Peaks, pinnacles, and bold granite buttes are the city's skyscrapers, its skyline. Sheer from the sea, and above shimmering sickles of sandy beach fringing the Atlantic and the bay, they soar heavenward on every side.

There's Gavea, whose name may mean either the crow's nest or the sail of a ship, but whose queerly shaped top seems with less fancy to form an old Crusader castle, complete with guard towers. There's Dois Irmãos, the Two Brothers, overlooking the seaside suburbs of Leblon and Ipanema.

Unmistakable landmark to Rio is Pão de Assucar (Sugar Loaf), a bare granite cone standing sentinel at the narrow gateway of the bay, with a spiderlike aerial tramway climbing up and down on its web strand from Urca.

Rearing high above the city is Corcovado, the Hunchback, a precipitous pinnacle that has become a 2,300-foot pedestal for a colossal statue of Christ. Beyond slumbers bulky Tijuca, with the profile of a reclining giant. These, and numerous other forested hills, segment the city or form its spectacular backdrop.

Not content with these wonders, Nature has marshaled countless other green hills and granite spurs to bracket island-studded Guanabara Bay.

CAPTAINS "PARK" THEIR SHIPS

In famed Sydney Harbour, Hong Kong and its broad roadstead, the Bay of Naples, and San Francisco, writers have sought comparisons. I have seen them all, but still I

THE SKIPPER "PARKS" HIS SHIP AT RIO'S FRONT DOOR

The cruise steamer *Franconia* ties up beside Praça Mauá at one end of Avenida Rio Branco, the capital's chief thoroughfare (Color Plate XVII). Passengers enter the city through the pleasant park. Beyond the pavilion of the Touring Club of Brazil and the Customhouse (left) extend long docks, where 4,000 ships are discharged annually. This view was taken from the offices of the American Consulate General in the 22-story skyscraper home of *A Noite,* one of Rio's leading newspapers.

was unprepared for the fantastic panorama of Rio and its vast aquatic amphitheater (see color series).

Once you shift your eyes from mountains or bay and begin picking out business blocks and residential districts from ship deck to convince yourself that perhaps Rio may be like many another port, save for its amazing setting, the captain starts *parking* the steamer!

Unbelief again!

Automobiles and carriages halt in parks; ships never. But they do—in Rio. Right alongside the formal square of Praça Mauá, or only a few berths away along the quays, all passenger steamers come to dock. Here are no grimy wharves to greet you; instead, you may pass through a bright, airy pavilion where a complimentary cup of Brazilian coffee serves as an introduction.

Neither do you have to thread blocks of unsavory streets or dingy alleys to get to the center of the city. The Avenida Rio Branco, Rio's Fifth Avenue or Champs Élysées, begins at the Praça where you walk down the gangplank. From water front to water front this wide resplendent thoroughfare cuts arrowlike across the peninsular heart of the capital.

At its upper end it joins the Avenida Beira Mar, "Edge of the Sea." This splendid marine drive skirts the park of Praça Paris, swings around curving Flamengo Beach, dodges the Mount of the Widow, describes a semicircle about the shore of Botafogo Bay, and halts in the shadow of Urca and Sugar Loaf (page 286).

Thence, changing its name frequently along the way, the avenue kinks again to avoid a hill, thinks better of it and plunges through a tunnel, to emerge now on the open ocean front where stretch the scalloping beaches and elite residential sections of Copacabana, Ipanema, and Leblon.

Photograph by Alfred T. Palmer

ONCE AN AQUEDUCT, NOW A BRIDGE FOR STREETCARS

Built in 1750, it conveyed the water supply of Rio between the hills of Santa Thereza and Santo Antonio until a more extensive system was installed for the rapidly growing capital. Its use as a car line will soon be ended if the hill of Santo Antonio is cut down to fill in the water front (page 304). Stalls of an open-air market often spread beneath its lower arches.

Eventually, miles beyond, the highway loses its marine identity amidst delightful mountain roads high up on the bastions of Mount Gavea.

But we go too fast. It is a thrilling scenic drive, replete with breath-catching charm. So let us return to the Rio Branco and begin a more leisurely tour of inspection.*

NEARLY 600 BUILDINGS RAZED TO MAKE ONE STREET

Better to appreciate the man-made portion of Rio today, one should flip back a few pages of history. Up to the turn of the present century, the town, like Topsy, "just growed." Its cluttered buildings, twisting, narrow streets, and lack of sanitation were profanations against its magnificent natural background. For long years the city almost continually had been a breeding center for fevers.

Then, in 1904, Rio began a vast program of renovation and rebuilding. Numerous buildings were torn down, streets cut, sea walls put around the water front, and sanitation measures instituted.

To carve out the one-and-one-half-mile-long Avenida Rio Branco alone, nearly 600 buildings were razed (Plate XVII).

Looking down some of the side streets that it severs, you gain a good idea of what most of the town was like years ago. The Rua do Ouvidor, aristocratic shopping center which crosses it about midway, is so narrow that no wheeled vehicles are allowed. Many of the others have become one-way channels for traffic.

The *Cariocas* (Rio residents) are proud of this 108-foot-wide business axis. Lined on either side and down the middle with trees, Rio Branco is a friendly thoroughfare.

* See "Gigantic Brazil and Its Glittering Capital," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE for December, 1930, and "Rio de Janeiro, in the Land of Lure," by Harriet Chalmers Adams, September, 1920.

A BREATH-TAKING PANORAMA OF TOWERING CRAGS UNFOLDS BEFORE VOYAGERS ROLLING INTO RIO'S HARBOR

Bold in outline, landmark after landmark comes into view as the arriving ship steams slowly in from the Atlantic (left), through the harbor entrance and into Guanabara Bay. Beyond Praça Paris (extreme right), the steamer moors near the Avenida Rio Branco in the heart of the city (page 284). Like a mighty river, the sprawling city starts in the hills, flows through narrow valleys, and spreads out on plains and crescents of sandy beach.

WHERE SKYSCRAPER APARTMENTS LINE COPACABANA, FISHERMEN DRIED THEIR NETS LESS THAN 40 YEARS AGO

Facing the open sea, the crescent-shaped beach is now Rio's Riviera and a favored residential district. Many private homes have given way to modern buildings and hotels. Beyond the hills in the distance, on another scallop of sandy beach, spread the still newer residential sections of Ipanema and Leblon (pages 290 and 299).

Three lanes of traffic move in each direction, while waiting taxis park parallel under the trees in the center.

Here are shipping offices, banks, Government ministries, cinemas, clubs, and cafes.

Parisianlike, some of the cafes spill out on the street, and if you sit at one of the tables, sooner or later you see all Rio pass, or stop for a drink. Cafes here have not lost the meaning of their names, for the Carioca drinks *coffee,* heavily sweetened as in the souks of the Levant.

WILDLY WAVING SEA OF STONES

Besides its language, one of the capital's most striking inheritances from its parent Portugal is its patterned sidewalks. But "Rolling Motion" Square and the main avenidas in Lisbon never had such areas of confusing stone paving.

Set with a mosaic of black and white stones, plazas and paths seem to billow and wave in the bright sunshine. Elsewhere huge butterflies, flowers, and countless formal patterns form the design.

In front of the Jockey Club a paved horse stares through a huge paved horseshoe. On the opposite side of the Avenida, at the Naval Club, rock fish swim gaily about steering wheels while seahorses cavort among tridents, crossed anchors, and life buoys.

If the Plaza of Floriano Peixoto, in front of Cinelandia, were a bit nearer, you feel sure that these vivacious marine creatures would swim over their chain boundary and frisk about in that wildly waving mosaic sea (Plates III and XXI).

Art in several forms centers around Praça Floriano Peixoto. Here is the Municipal Theater, with a flavor of the Paris Opera in its architecture. Here, too, is the Bellas Artes, or Academy of Fine Arts, and beside it the National Library.

When Napoleon pressed his campaigns into the Iberian Peninsula in the early 1800's the Portuguese rulers, Dona Maria I and her regent son Dom João VI, hastily picked up their baggage, throne, and court and sailed over to Rio to await the time when war clouds should blow over.

Among their quickly assembled possessions which they loaded on shipboard were many paintings and the books and rare manuscripts of the Royal Library. Though the court returned to Lisbon in 1821, after a sojourn of 13 years, these remained in Rio and formed the nucleus about which the gallery and library have grown.

Across the way, and around the corner facing Passeio Publico, is the realm of celluloid—Cinelandia (Plate XXI).

HOLLYWOOD MOVIES PREDOMINATE

Of ten motion picture houses grouped here, I saw one showing the new Brazilian film "Banana da Terra," and another a German film. All the rest were American productions. Advertised changes of programs were also American, except for one British film.

Perhaps one should include in the category of art the Institutos de Belleza and Cabelleireiros para Senhoras (beauty salons and ladies' hairdressers), for the women of Rio keenly follow the styles of upswept hair, or whatever the mode of the moment happens to be, and sit for "Ondulações permanentes, Tinturas e Manicures" (permanent waves, dyeing, and manicures).

Standing alone in the square beside the obelisk that marks the upper end of Avenida Rio Branco, is Monroe Palace. This ornate structure housed the Brazilian exhibit at the St. Louis Exposition of 1904 and was later dismantled and moved here. Seat of the Federal Senate until that body was dissolved, Monroe Palace is now in use by the Ministry of Justice (Plate III).

To the right stretches Praça Paris, built, during Rio's rebuilding campaign, on land reclaimed from the sea. With its sparkling fountains, formal gardens bordered with flowers, hedges trimmed in fantastic shapes of animals, pavilions, and fancy pillars, and its wide, pleasant walks, the Praça is a delightful place beside the bay.

Before continuing along the marine drive, let us make a short detour to the left, where many new buildings are rapidly rising.

CITY COOLED BY REMOVING A HILL

Once a high hill, the Morro do Castello, stood here. On it Rio began its permanent growth in the late 1500's when that industrious colonizing leader Mem de Sá and his nephew Estacio de Sá settled the issue as to whether this should be a French- or Portuguese-speaking land by routing the French from near-by Villegaignon Island.

In 1922 engineers began work with hydraulic machinery to sluice the hill into the bay. In doing so they created an airport, added some 14 blocks to the business section, and air-conditioned the city!

ONE OF THE FINEST IN THE WORLD IS THE RACECOURSE OF THE RIO JOCKEY CLUB

Nestling beside the blue waters of Rodrigo de Freitas Lagoon beneath towering Corcovado, this famous track draws visitors from all South America. Like the visor of a jockey's cap, grandstand roofs jut out over the spectators. No supporting columns block their view (page 299).

Yes, air-conditioned. The hill hitherto had blocked off the sea breezes, and when it was leveled the temperature in the downtown area dropped more than five degrees.

Several ministries are to occupy the site of the Morro. Already the Ministry of Labor, Commerce, and Industry is completed and the 15-story skeleton of the offices for the Ministry of Health and Education has reached its full form. Glass windows will almost wholly encase its sides.

PLANES TO UNITED STATES AND EUROPE

A moment's walk from this center, and only a few minutes' drive from any part of the business district, is the Santos-Dumont Airport, one of the most centrally located land- and seaplane terminals of any city in the world (Plate XXII and page 302).

Pan American Airways Clippers come skimming down the bay twice a week from Miami and take off again on their homing flight. Land liners then speed passengers and mail back and forth to Buenos Aires, and link with lines on the west coast.

Smaller Panair do Brasil seaplanes connect coastal cities and the Amazon, while land planes radiate out to Porto Alegre, Recife, Bello Horizonte, Uberaba, and Poços de Caldas. The local VASP darts back and forth to São Paulo twice a day.

French and German routes bring Europe next door. British and Italian services also are projected.

Moored to one corner of the air base by a bridge is Villegaignon Island where, in 1555, the French planted their colony and stayed until finally ousted by Estacio and Mem de Sá twelve years later. Gray modern buildings of a naval school now cover its surface, but around its base several rusty cannon remind one of some of

the earlier exciting days in the Guanabara.

A block or so from the air terminal is the Caes Pharoux, the embarkation point for the ferries that ply the bay. Nearly 58,000 fares pass through the turnstiles every day. Most of the passengers commute between Rio and Nictheroy across the harbor, though 5,800 ride back and forth from Governador Island and another 2,000 explore the idyllic charms of Paquetá Island, far out in the bay (Plates VII and XXIV).

RIDE BAREFOOT AND SAVE A CENT

Here is probably the cheapest ride on earth, this trip to Paquetá. A three-hour round trip on the leisurely side-wheeler cost me a nickel.

I could have gone even more cheaply—barefoot! Timetables parenthesize *descalço* (barefoot) in listing second-class fares. On bare feet you walk through one turnstile; with shoes on you walk through another. On the ferry there's no distinction, but on the round trip you save a cent!

The twenty-minute trip to Nictheroy is about three cents for those fully shod; descalço is two. Years ago when the regulation was made, *milreis* were worth more and the difference between first- and second-class fares meant much to barefoot workers.

Returning again to the Avenida Beira Mar, we head toward Sugar Loaf. Along Flamengo Beach hundreds go swimming, while others line the sea wall and look on. In the evenings the walls are again crowded with persons enjoying the cooling breezes (Plate VIII).

At Botafogo Bay, farther on, Cariocas take to the water much more seriously. Here are regatta clubs, whose strong-limbed, bronze-backed members go scooting over the bay in long, slender shells. Here are clubs where, if one doesn't want to join in the strenuous cross-bay swimming contests, he can dip in an artificial pool.

Here, too, is the Fluminense Yacht Club, with many trim sailboats, speedboats, and launches riding at anchor or cutting white wakes in the water. Pontoons of aviation school planes also kick up long banners of spray as they taxi back and forth and take to the air.

DIZZY ASCENT TO SUGAR LOAF

A good second best to flying is the aerial cable car ride up to the peak of Sugar Loaf, some fifty feet taller than New York City's Empire State Building. The ascent is made in two stages. The first swings out and up over Praia Vermelha to the top of Urca. The second line cuts high over a forested ridge and rises toward the sheer granite wall of Sugar Loaf, 1,300 feet above the sea.

The timid need not worry, for cables and cars were designed to support 150 times the weight they carry! Cars cease operating if there are high winds. Nerve tension need come only from the spectacular view that unfolds.

From this lofty vantage point Rio takes on new color and contour. Another dimension seems suddenly to have been added to the majestic peaks and the broad bay.

Save in form only, the view is never twice the same. Under the brassy sun at midday, or when violet and blue tones creep up the mountain sides in the evening, as long ribbons of mist hang in the zigzag valleys, or again at night when the lights appear like strings of golden beads and wavy pendants against purple velvet, the color changes are kaleidoscopic.

Going up one afternoon in the hope of picturing a tropical sunset, I asked the car conductor if he ever looked at the scenery.

"I've gone up and down twelve years now; it's an old story," was his reply.

"But there are times when seas of clouds rise and fall, and in moonlight when the view is——," and he touched his ear lobe with his fingers in a Brazilian gesture to indicate that here was something exquisite.

On one ascent I met Miss Sugar Loaf. This five-year-old youngster bears the distinction of being the only person born on the peak and was appropriately given the name of Pão de Assucar. Her father cuts silhouettes of many visitors who come up to enjoy the aerial vista.

COLD CURRENTS IN THE TROPICS

Outside the bay, its three-mile crescent of sandy beach washed by Atlantic rollers, is Copacabana, Rio's delightful Riviera. Only a few years ago this coastal strip was largely barren waste, where fishermen dried and repaired their nets. Now tall apartments, hotels, and aristocratic homes fill the whole area (Plate XIX and page 287).

Thousands swim, breast the breakers, play handball and *petéca* (a large feathered shuttlecock batted with the hands), or just loaf on the sands and acquire sun tans.

One day I went out for a swim, however, and got a shock that reminded me of the

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Kodachrome by W. Robert Moore

SUGAR LOAF, GAUNT SENTINEL, GUARDS THE PORTAL TO RIO DE JANEIRO

Cars suspended from aerial cableways carry visitors to the 1,300-foot pinnacle. From sprawling Red Beach (right) one skyway rises 750 feet to the white station on the summit of Mount Urca (center). Another car continues the dizzy ascent to the top of the big dome, where a breath-taking view of the city, mountains, and island-studded bay spreads below (Plate VI).

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Kodachrome by W. Robert Moore

HOW CAN HE KEEP HIS HEAD DOWN WHEN SCENIC HAZARDS ALL AROUND DISTRACT?

On other greens and fairways of the Gavea Golf and Country Club, views of the blue sea, virgin jungle, a row of flamboyants, or a white-steepled church conspire to multiply scores. The club is reached by a coastal road opened by Albert, King of the Belgians, when he visited Brazil in 1922.

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BRAZIL'S PRESIDENT DWELLS IN MARBLE HALLS

Royal palms flank the avenue leading to Guanabara Palace, one of President Vargas' three large residences. Before the country became the United States of Brazil in 1889, this building was the home of royalty.

Kodachromes by W. Robert Moore

MOSAIC PAVING WAVES AND BILLOWS IN DAZZLING SUN

On a hot day the curved patterns in black and white stones seem to melt and run away. Granite Monroe Palace, beyond, housed Brazil's exhibit at the 1904 St. Louis Exposition. It was moved here and rebuilt, stone by stone.

A RED-WINGED SNIPE SKIMS OVER THE BLUE LAGOON

One of the Two Brothers peaks, and flat-topped Gavea Rock, both Rio de Janeiro landmarks, form a backdrop. At the water's edge, right, rises the stadium of the Flamengo Yacht Club.

© National Geographic Society Kodachromes by W. Robert Moore

ON A ROCKY SHELF BESIDE THE SEA, FISHERMEN MEND THEIR NETS

Sharks, eels, and cuttlefish are mixed with fine food varieties when hauls are made. Rio anglers find a paradise when the bluefish run here, on the eastern side of Guanabara Bay.

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Kodachrome by W. Robert Moore

PILGRIMS CLIMB 365 STONE STEPS TO REACH PENHA CHURCH ON THE ROCK

Thousands, observing the annual October festival here, formerly made the ascent on their knees. Now the practice is forbidden because, as worshipers increased, accidents became frequent. On the wall a health brigade member has placed a yellow flag to show the house is undergoing sanitary inspection.

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Kodachrome by W. Robert Moore

RIO'S MOUNTAINS, SEA, AND WORKS OF MAN BLEND IN A MIGHTY PANORAMIC SYMPHONY WHEN VIEWED FROM SUGAR LOAF

The broad back of Mount Urca (Plate I) looms in foreground. Below it, at left, formal gardens take the place of the barracks which housed a mutinous regiment. The Third Infantry rebelled in November, 1935, and its quarters were wrecked by shellfire of loyal troops. Two vehicular tunnels now pierce the rocky heights beyond, which formerly separated Copacabana Beach (left) from Botafogo Bay (right). Corcovado, surmounted by its giant statue of Christ, towers in right background.

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SANDY BEACHES ARE RIO FRONT YARDS

Fashionable apartments, of ultramodern architecture, line the Avenida Atlantica near the heart of the city.

Kodachromes by W. Robert Moore

MERMAID, CARIOCA STYLE

Having just been awarded the title "Miss Brazil," she has come to Paquetá Island, quiet resort in Guanabara Bay, for an outing (Plate XXIV).

SEA BREEZES COOL STROLLERS ON FLAMENGO PROMENADE

© National Geographic Society Kodachromes by W. Robert Moore

RIO RELEGATES LUMBERING OXEN TO THE SUBURBS

The yoke, hauling a cart laden with stones, will not be permitted to enter busy traffic areas.

times when, as a youngster in Michigan, I tried to be the first to go swimming in early spring. The chilly water dissipated any unbelief that I might have had regarding the story that two live penguins drifted up on the beach a few years ago!

By a strange quirk of winds or tides, cold currents occasionally sweep in close to shore. They seem to come straight from the Antarctic, though the water probably shows a less marked drop on a thermometer than it does on the enthusiasm of bathers used to the normally warm temperatures.

Ipanema and Leblon, on another curve of the coast, are more recent suburban developments than Copacabana. Back of the narrow strip upon which they have grown is the large Rodrigo de Freitas Lagoon, connected with the sea by a narrow canal.

A short detour around one side of this reach of water brings one to the Jockey Club (p. 289). Whether one wishes to place a few milreis on the "winner" or not, the course is worth a visit, just to see its elaborate buildings and lovely surroundings. The courses of Melbourne, Longchamp, Santa Anita, or many another cannot surpass it. Horses on the home stretch seem to be thundering straight down from the pinnacle of Corcovado, or from an avenue of royal palms in the Botanical Gardens.

The mention of royal palms immediately suggests a visit to the Gardens, for here is the mother palm to all the hundreds of tall, columnar, duster-topped trees that lend grace to gardens and streets.

The "palma mater," though old, is still lusty. Brought from Mauritius Island in 1809, it was planted by Dom João VI when the Portuguese court ruled in Rio.

"We take every possible care of it," said the director. "Several times it has been attacked by lizards; we've even called the fire department to clear them out."

BRAZIL GETS ITS NAME FROM A TREE

Not far away from this historic palm I was shown specimens of trees that also made Brazilian history—in fact, gave the country its name—the *pau brasil.*

Spiny of trunk and limbs, these trees were used as dyewood. Pieces of the wood, which Amerigo Vespucci and other early explorers took back to Europe, suggested red-hot coals, or *brasas.* So Brasil, or Brazil, the country became, rather than Terra da Vera Cruz, which the Portuguese navigator, Cabral, first called it.

In the library of the Ministry of Foreign Affairs I later saw an original map, dated 1512, on which the name "Brasil" appears for the first time. It is spelled with an "s," as is the official Brazilian usage today, rather than with a "z." On the same map our Atlantic seaboard still carried the name "India Nova"!

In the Botanical Gardens one can also see huge clumps of giant bamboo, traveler's palms that store up water, and cartwheel-size floating leaves of the victoria regia that will hold up a child.

"Here's an interesting specimen," said the director, pausing beneath a tall, straight, sparsely limbed tree. "It's the *pau mulato,* from the Amazon region, which shipbuilders use there as masts."

"Don't touch it," he cautioned as I reached out to rub my fingers over the glossy, chocolate-colored bark that seemed to have the texture of satin. "It is so delicate that your nails will cause an abrasion. See what happened when one man put his hand against it."

There was a scar where each of his five fingers had pressed. Though thin-skinned, the tree has a formidable enough scientific name—*Callico phyllum spruceanum.*

Beyond Leblon the coastal road becomes Niemeyer Avenue; it was inaugurated by Albert, King of the Belgians, during his visit to Rio.

SCENIC HAZARDS BEGUILE THE GOLFER

I am not a golfer, but were I an expert I should dislike playing a competition match on the course of the Gavea Golf and Country Club. I'm sure my score would be about 250, instead of the Club's par of 69. Scenic hazards are too great.

Tee off for your first drive and your eye is distracted by a row of palm trees and the precipitous slopes and castellated top of Gavea Mountain. The second hole gives another visual handicap, for your glance strays at once to the strip of blue sea or to the peaks of the Two Brothers.

Even should you get accustomed to these by the time you've reached the fifth hole, the sixth will add new hazards of purple-flowering bushes and a wall of green forested hills. Later, virgin jungle, a row of flamboyants, or jack fruit trees and singing birds divert your attention from the game.

At the twelfth you drive straight up the narrow ridge of a hill. Once you gain the top, there's a horseshoe of mountains on

BRUSH MEN MAKE THE ROUNDS IN RIO, TOO!

Carrying an assorted collection of brushes, feather dusters, brooms, and even a wicker wastebasket, he climbs up and down the steep hills, visiting residential districts. Prices are cash and delivery immediate—no free samples!

three sides; the sea is on the other. Even a charming white-steepled church, perched on a hill, conspires to multiply your strokes.

Yes, I'm sure that I'd rule out competition golf on the Gavea course, and make the game an excuse only for looking at the scenery (Plate II).

FISHING UNDER THE SOUTHERN CROSS

From the seaside slope of Gavea the main road twists inland. Another winds down to sea level beside Tijuca Lagoon, where Brazilian friends invited me to go fishing one night by moonlight.

We caught few fish, though one of the men cast his circular net hundreds of times where we saw silvery flashes in the water. But it mattered little. Seeing the dark bulk of Gavea silhouetted against the moonlit sky and the Southern Cross riding high in the heavens, I felt amply recompensed for staying out till nearly sunrise.

Even more than Australia, which is often called the Land of the Southern Cross, Brazil uses this group of stars as an emblem. The Cross appears on the national coat of arms, on postal boxes, buses, airplanes, shops, and on several of the small coins. The all-sleeper night express that runs between Rio and São Paulo is called the Cruzeiro do Sul.

"If you want to keep your bearings going about town, look for Corcovado. The statue of Christ faces eastward over Botafogo Bay," a friend told me when I first arrived in Rio.

STATUE OF CHRIST A LOFTY LANDMARK

From almost any section of the city the monument atop the sharp peak is a conspicuous landmark, day or night. In the evening, when its floodlights are turned on, it appears alabaster white against the dark sky.

Go up to the terrace at the base of this towering figure and you gain an even more

aerial-like view of the city than from Sugar Loaf, for it is a thousand feet higher.

Of preference, make the visit in the afternoon when the sun is at your back. Stay and watch the sharp-pointed shadow of Corcovado creep across the city toward the peak-punctured bay. By that time you have lingered long enough to wait a bit longer for the lights to be turned on.

Like lightning bugs they begin to shine, blink, and quiver. More and more join until you think you see millions spread out far below you. Technical men may quibble about relative candlepower, but none can deny that Rio's public illumination is one of the most effective in the world.

"EX-TRA! READ ALL ABOUT IT!"

Thus, in its Portuguese equivalent, seems to cry the bronze newsboy of Rio. With wide-open mouth, floppy hat, and patched trousers, he would be at home on any busy street the world over. Placed here by one of the city's newspapers, he qualifies as the capital's quietest newsy.

Both a cogged railway and a motor road wind up the mountainside close to the summit of the Hunchback. Much of the way the route passes through forests. Lianas trail from many of the trees. Splashing the green foliage are yellow-flowering acacias, purple Quaresma, and silvery imbaubas.

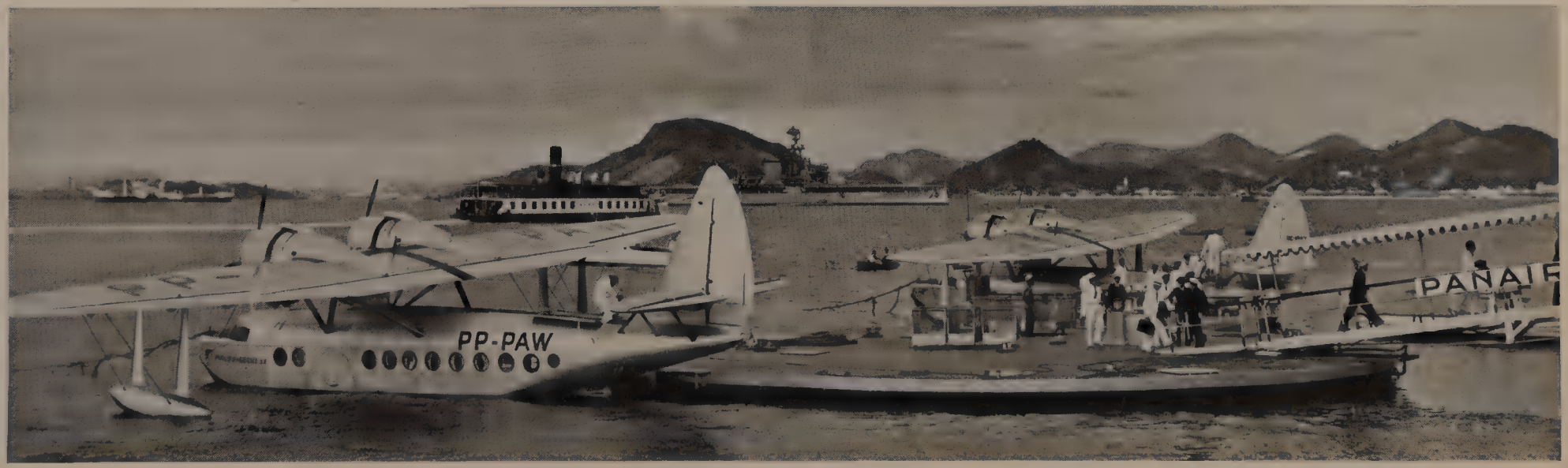
The Quaresma, or Lent, bushes are so named because they are usually in full bloom during the Lenten season. On some of Rio's hillsides they seem like light purple clouds. The slender candelabra-limbed imbauba trees owe their silvery luster not to flowers, but to the fact that the older leaves turn whitish on their upper surfaces before they drop off. The young red-tinted leaves appear in a cluster, unfold like a yawning dragon mouth, and eventually spread out like fingers and turn green.

KALEIDOSCOPIC CITY FROM THE AIR

On the mountain roads to Mesa do Imperador (Emperor's Table, where Dom Pedro II used to sit and read state papers while enjoying the view), Chinese Vista, and other spectacular lookouts high up on the slopes of Tijuca, are also many jack fruit trees imported from India, with huge

Photograph by Jeannette Sellers

THE RAIN SQUALL HAS PASSED, SCHOOLS OF FISH ARE IN THE BAY, SO THE FISHERMEN MAKE A RAPID HAUL



TWO SKYLINERS COME TO REST IN GUANABARA BAY BESIDE THE NEW SANTOS-DUMONT AIRPORT

One has just arrived from the Amazon; the other, still discharging its passengers, has winged down from Miami on the twice-weekly service of Pan American Airways.

BUS PASSENGERS ALONG THE AVENIDA RIO BRANCO FIND ALL HOURS ARE RUSH HOURS

Here they pause on the mosaic pavement near Rua do Ouvidor, the city's elite shopping lane. Portuguese-speaking Rio has an estimated population of 1,800,000—second only to Buenos Aires in South America, and larger than any city of the United States except the "big three," New York, Chicago, and Philadelphia.

light-green fruit growing from their trunks and limbs.

"Would you like to have a real view of Rio?" asked a young Brazilian who called on me one morning.

"From where?" I inquired.

"The air."

I needed no second invitation. Soon we were soaring over the city, its marvels multiplying as the altitude needle rose on the dial. As we banked sharply above Corcovado, all Rio became like a giant fireworks pinwheel spinning on this pivotal peak. When we looked down on the Avenida Rio Branco, it seemed as if a ship had plowed straight through the town, leaving a green and white wake as it passed.

Motoring about Rio, one is aware that chauffeurs make circuitous detours; from the air one sees why. Like slender rivulets, the city starts in the hills, runs through narrow valleys, and spreads out on the beaches and plains bordering the bay.

Some sections seem close enough together for one to stand on top of the dividing ridge and toss pebbles onto the roofs on either side; yet one may have to travel miles to get from one locality to the other.

From high in the air, Guanabara Bay becomes surprisingly like a map picture of entire Brazil. But the similarity ends with its outline. The blue water is strewn with a hundred islands, large and small. Bare granite boulders, not large enough to be called islands, are also scattered about.

Big Governador Island fills a sizable area in the northwestern corner of the bay. Paquetá, with its palms and circlet of white beaches, is a gem even from our 5,000-foot altitude.

"Those arrow-shaped pointers in the water are fish traps," the pilot volunteers.

We swing over marshy flats on the northeast side of the bay. Through them course several serpentine streams, some of the loops almost folding back on one another.

"The Government plans to rectify these streams and carry out drainage projects so that the entire area can be converted into fertile gardens. The fields you see are bananas and oranges," he tells me.

SKYWARD-POINTING "FINGER OF GOD"

Climbing steadily, we clear and circle the Organ Mountains. Their name is derived from the organ-pipe appearance of several tall sharp crags.

One of the outstanding pinnacles is called the Finger of God. From some angles it looks remarkably like an up-pointed index finger, other rocks forming the knuckles of the closed hand.

These mountains form part of the barrier that reaches a thousand miles along the coast. Because of the range, the majority of Brazil's population and development has been concentrated along the seaboard.

The circuit over the hill resort towns of Petropolis and Therezopolis is a matter of moments. Petropolis was the summer capital of Dom Pedro II while he was emperor. Brought back from Europe, the bodies of the once-exiled ruler and his consort now lie in the Petropolis cathedral. Members of the royal family still live in this delightful hill town.

Like a tangled thread thrown at random on the mountains is the excellent concrete highway that links Petropolis with Rio. A cogged railway also climbs the steep slopes; in some places its track tilts at an angle of 19 degrees.

RIO LOOKS TO THE FUTURE

Back to earth again, I went out to see what the City Planning Commission intends to do to Rio in the near future.

Some of the maps and large models of projected changes that its director, Dr. José Oliveira Reis, showed me were as striking as the contrasts between photographs made of some areas twenty years ago and now.

"We're going to pull that down as we did Morro do Castello," said the doctor, pointing to Santo Antonio hill just back of the Rio Branco and Praça Paris.

"We shall use the earth to fill in between the corner of the airport and Praça Paris to make gardens and public playgrounds. The Avenida Beira Mar will be widened and a high-speed thoroughfare put all along the bay. That means one new tunnel and the widening of the one on the way to Copacabana.

"From the civic center we're now building on the site of the old Morro, we're extending the marine Avenida into a perimetrical thoroughfare. The central market by the quays will be replaced by commercial shops and apartments."

On a large wall map the doctor also traced several red lines where arterial streets were to be built to shorten routes and reduce traffic on the Avenida Rio

Branco and in other congested districts.

One of these schemes, that of cutting a path straight through the business district in line with the palm-bordered Mangue Canal, is far more ambitious than was the creation of the Rio Branco. The canal is to be covered with a speedway leading to the suburbs and the São Paulo highway.

UNHATCHED CHICKS HELP CURB YELLOW FEVER EPIDEMICS

Partially incubated eggs are "needled" with fever virus; the tiny hole is sealed with paraffin, and the embryo allowed to develop for a few more days. The chick tissues are then dried, pulverized, and converted into vaccine, the virus having lost its dangerous properties to become a mildly reacting safe immunizer. With this recently developed vaccine, more than a million persons were inoculated against jungle fever last year (page 306).

COMBING THE CITY FOR MOSQUITOES

What General Gorgas did for Habana and Panama in stamping out yellow fever, Dr. Oswaldo Cruz did for Rio in the early 1900's. Rio was cleared of a scourge that had plagued her since 1849.

But the work still continues. Yellow fever workers comb the city, systematically searching for mosquitoes and for places where they breed. To keep a clean city clean is easier than to try to clean it up should an epidemic strike.

One day I went out to watch the anti-mosquito inspectors at work. I saw them searching every nook and cranny in gardens and inside the houses, looking for breeding places—leaky faucets, tin cans, in leaves of banana plants, drains, bathrooms, water jugs, and plant jars. Tin cans are punched full of holes, drains sometimes dosed with oil, and careless householders first are warned, then reported and fined.

Other workers hunt for live mosquitoes. With flashlights they examine walls, peer under tables, chairs, beds, and behind bric-a-brac, yes, even inside hats on a hanger. If they spot a mosquito they catch it in a suction gun and chloroform it so that its species may be determined.

Two men whom I saw had worked all morning and had caught but a single mosquito; it was not a *Stegomyia*.

Clear up the few endemic centers and yellow fever will vanish, sanitarians once thought; now they know differently. Just

when it seemed that yellow fever would be banished from the Americas, a new problem entered the picture.

It was jungle yellow fever.

How does that concern Rio? From Brazilian and Rockefeller Foundation doctors who are co-operating in the yellow fever services I learned the answer.

FEVER FIGHTERS DEVELOP NEW VACCINE

Unlike urban yellow fever, which flourished in large centers of population and was transmitted from man to man by the mosquito *Aëdes (Stegomyia) aegypti,* jungle yellow fever appears in sparsely populated districts. Monkeys and perhaps other jungle animals are infected; other mosquitoes than *Stegomyia* also are carriers. That much scientists know; there are other factors yet to be disclosed. Man's part in the cycle of infection apparently is purely accidental.

But so long as people working in the fields close to the forests become infected, there is always the possibility that yellow fever may thus be transmitted to town. So Rio chases mosquitoes, while yellow fever specialists sweat in their laboratories to circumvent such an occurrence.

"Obviously, we can't kill off all the monkeys and mosquitoes in the vast South American jungles, but fortunately we now can vaccinate," said one of the doctors.

After years of patient research an effective preventive weapon has been found. In air-conditioned chambers I saw this vaccine being prepared. One room looked more like a hatchery than a scientific laboratory, as in it hundreds of hens' eggs were being incubated.

One stage of the preparation of the vaccine consists of inoculating partially incubated eggs with virus and then allowing the embryo to develop briefly (page 305).

Yellow fever research in the field and in the laboratories of the Yellow Fever Service on the grounds of the Oswaldo Cruz Institute ranges from studying monkeys, experimenting with mice, and examining all cases of sudden death from fevers, to keeping mosquitoes infected with deadly yellow fever within multiple screen cages.

The Oswaldo Cruz Institute itself is one of the finest research organizations in South America. It conducts extensive work in tropical medicine and manufactures serums and vaccines for human and veterinary uses. Its numerous departments range through most of the gamut of natural history "ologies." Bugs, butterflies, and bacteria are all studied and catalogued in this building of Moorish design.

In one laboratory are bottled and studied more than 9,000 worms, large and small. In another room I saw keen-eyed scientists giving artificial respiration to a frog!

Just offshore, on Pinheiro Island, is a marine biological station. Here, too, is a monkey farm where two hundred animals live freely under natural conditions. To see them go to the beach to take baths almost like humans is an amusing sight.

HERE CALL 4,000 SHIPS A YEAR

Several times while in São Paulo I heard the remark: "In São Paulo we work; in Rio they play."*

True, Rio does not have as many large mills and factories, but the people work. For one thing, Rio's dock workers handle three million tons of cargo that are picked up or discharged by the 4,000 ships that enter and clear the harbor every year.

Large quantities of foodstuffs and materials for local consumption are also processed in this city of some 1,800,000 inhabitants. And, as in Washington, D. C., many residents are Federal employees.

Not all of the 556,000,000 fares that catch streetcars every year, nor the 80,000,000 bus goers and 2,800,000 ferry riders are entirely pleasure bent!

Incidentally, in Rio, streetcars are never called street cars or even trams; they are always *bondes.* This curious name comes from the fact that the first tickets sold on the cars appeared at the same time as the issue of bonds for the national loan in 1868.

GAY RIO IN CARNIVAL MOOD

Yes, Cariocas work; but they also play.

One of the most amazing things in this amazing city is Carnival (Plates IX to XVI). Officially, it lasts for the three days preceding Ash Wednesday. Actually, the people begin parties and beach parades weeks in advance.

"This isn't Carnival," several told me when they saw me taking photographs of the paper-costumed dancers on the beaches. "Wait till real Carnival."

"Carnival is madness," said a doctor who was driving me around Rio one day. "I

* See "As São Paulo Grows," by W. Robert Moore, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1939.

"ON WITH THE DANCE! LET JOY BE UNCONFINED!"

All Rio de Janeiro heeds Byron's words and joins in the annual three-day pre-Lenten frolic. Thousands of costumed merrymakers take over the city streets.

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A LULL BEFORE THE STORM—OF CONFETTI!

Soon they will be in the thick of the automobile parade, for which nearly every car in Rio is pressed into service.

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A MUSICAL HIT, "GIRL GARDENER," INSPIRED THIS COSTUME

Kodachromes by W. Robert Moore

PIERRETTES SEEK A TARGET FOR THEIR STREAMERS

© National Geographic Society

Kodachrome by W. Robert Moore

IMAGINATION RUNS RIOT WHEN CARIOCAS DESIGN CARNIVAL GARB

Gaily clad workmen band together in *blocos*, or groups, and tour the streets, singing and dancing day and night. Though hundreds of songs are composed each year in Rio de Janeiro's Tin Pan Alley, two or three of the most popular airs are sung over and over to the exclusion of all others.

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TAMBOURINE DUET

Kodachromes by W. Robert Moore

"BEAUTIFUL FLOWER" PERSONIFIES A 1939 CARNIVAL SONG

© National Geographic Society

Kodachrome by W. Robert Moore

TO THE HYPNOTIC THUMP OF DRUMS AND TAMBOURINES, A WORKMAN'S GROUP STRUTS DOWN AVENIDA RIO BRANCO

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"PRINCESSES" RUB SHOULDERS WITH THE THRONG

Kodachromes by W. Robert Moore

BUCCANEER AND INDIAN WALK ARM IN ARM

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FANTASTIC CARNIVAL WARRIORS HAIL A DOUGHTY "AMAZON QUEEN"

Among the crowds that watch the parades are visitors from the United States. Cruise boats plan their itineraries to be in Rio de Janeiro at Carnival time.

A CARIOCA ORIENTAL AMUSES ONLOOKERS WITH HIS FOOT-POWERED MOUNT

© National Geographic Society Kodachromes by W. Robert Moore

STREAMER- AND CONFETTI-STREWN CARS ARE MASSED IN THE CARNIVAL PARADE

Occupants in gay overalls pause for a breathing spell on Flamengo Drive. "Embassy from the Garden of Allah," reads the funmakers' banner.

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ENGINEERS CUT AVENIDA RIO BRANCO THROUGH RIO'S HEART IN SIX MONTHS

To carve the city's "Main Street" across a maze of narrow streets and crowded buildings, 590 structures were razed. The boulevard stretches for a mile and a half from north to south, linking the harbor with Flamengo Bay (background). The photograph was made from the 22-story building of the newspaper *A Noite*. Cafe patrons sip coffee under the trees on the wavy sidewalk, Paris fashion.

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FROM CORCOVADO, RIO GLISTENS LIKE A JEWEL IN ITS SETTING OF BLUE SEA DOTTED WITH PURPLE AND JADE MOUNTAINS

At the foot of Sugar Loaf (right center) nestles the fashionable residential area of Urca, on filled-in land. A Coast Artillery fortress occupies the white speck in the channel entrance, less than a mile wide. The Flamengo district lies in left foreground and directly beyond, across the harbor, is Nictheroy.

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CARIOCAS BATHE IN THE SEA ALL YEAR ROUND

Copacabana Beach is only fifteen minutes from the heart of the city. Unlike New Yorkers, whose trip to the seashore calls for a long subway or automobile ride, most Rio de Janeiro residents can reach their favorite bathing place by walking. All morning long the sand swarms with people; a quick dip during lunch hour is common for office workers. Virtually every apartment house fringing this section has been erected in the last ten years.

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FOREST-CLAD SLOPES REACH UP TO THE GIANT FIGURE OF CHRIST ON CORCOVADO

Sailors far out at sea can spot the inspiring figure, 130 feet high, on its rocky eminence 2,300 feet above the sea. The summit of "The Hunchback" is reached by funicular railroad and highway.

RIO'S "CINELANDIA" FRONTS ON A PLAZA

Nearly every office building in this section (right background) houses a motion picture theater on its main floor. At the end of the tree-lined square is Monroe Palace (Plate III). The Municipal Opera House stands in right foreground.

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SERPENTINE PAVING LEADS TO BRAZIL'S SUPREME COURT BUILDING

The National Library (left) and the Academy of Fine Arts front on the broad Plaza of Floriano Peixoto.

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Kodachrome by W. Robert Moore

LAND AND SEA PLANES FROM FAR AND NEAR ARRIVE AT SANTOS-DUMONT AIRPORT

Behind the landing field a new business section has sprung up, where once stood Castle Hill. Rio de Janeiro razed the hill to ventilate congested areas better, and dumped the earth into the bay to make the airport. The jetty at right encloses a destroyer and submarine basin, part of the new navy yard.

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INLAND FROM CRESCENT-SHAPED BOTAFOGO BAY, APARTMENTS AND HOUSES BY THE HUNDREDS STRETCH ROW ON ROW

In extreme background is the racecourse of the celebrated Jockey Club. Tree-lined Avenida Oswaldo Cruz, in right foreground, is known as "The Avenue of Connection" because it is one of the principal thoroughfares which link Botafogo with Flamengo Bay (Plate XVIII).

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Kodachrome by W. Robert Moore

FLAMBOYANT TREES AND BROMELIADS LEND A JUNGLE TOUCH TO PAQUETÁ

Rio visitors to this island resort in Guanabara Bay, where automobiles are barred, explore wild tropical growth and exotic gardens from timeworn victorias.

shall escape it by going out of town." A moment later, quite unconsciously, he was humming one of the popular Carnival tunes and tapping out the rhythm on the car.

More and more Carnival copy filled the newspapers. At first programs and pictures appeared under a banner head, "Carnival," on an inside sheet. Later they invaded the front pages, and among illustrations of floats I found: "Mussolini Escapes Death, see page 2"; "Sr. Oswaldo Aranha confers with Mr. Sumner Welles, see page 3." Many papers announced limited editions or none at all on Carnival days.

Rio's equivalent of Tin Pan Alley spends months prior to Carnival hammering tunes on battered pianos, picking them out on guitars, and thumping them out on drums or anything that will make a noise. In one booklet I saw 280 songs. From these emerged four or five hit tunes.

WHOLE CITY MOVES TO MUSIC

On radios, in night clubs, among musical organizations, at Rio's social clubs, and on the street you heard the ones that caught on. These celebrants sung, tom-tommed, stamped to in parade, and danced to over and over again during the days of Carnival.

On Carnival Saturday tom-toms began beating and the sound of chanting swelled as if some weird jungle rite were beginning. Throughout the afternoon and evening crowds surged through the city—wild feathered Indians, men burlesquing in women's dresses, women in men's outfits, clowns, sailors, and countless other characters.

Almost anything made a costume. For a few cents one could buy a yellow sweat shirt or a yellow derby and be in Carnival style.

In groups large and small, sometimes singly, they danced and jigged with the distinctive Brazilian movement of hips, shoulders, and feet to the insistent hypnotic thump of drums, tambourines, and grunting *cuicas*. (A cuica, usually made from a keg, resembles a long drum with a resined string attached to the inside of the head; this when pulled gives *Uup Uup* sounds that seem a cross between a bass viol and the croak of a bullfrog.)

"This isn't Carnival; wait till tomorrow," said several friends.

"What then *is* Carnival?" I wondered.

At nine o'clock next morning small groups appeared on the Rio Branco outside my hotel; at noontime there were thousands. By midafternoon buses were rerouted from the Avenida, and in their stead four lanes of cars wedged through the surging crowds. In one car I counted twenty people; ten to fifteen was a common load.

Here were Pierrots, Pierrettes, comely pirates, Portuguese, and Russian princesses; bulky Bahianas, laden with shiny beads; fantastic cats, girl gardeners, and grass-skirted Hawaiians; people in Scotch plaids, Spanish mantillas, and baggy Syrian pants.

Here, too, were Turks, Tatars, Tyroleans, tar babies, and enough satin-clad soldiers and sailors to take Rio by land or sea.

CONFETTI BY THE TON

Countless tons of confetti and serpentines were tossed between cars and over the crowds. Everyone carried small glass or metal siphons of etherized perfume and shot it everywhere. Legs, necks, and bald heads were favorite targets for the quick-drying icy streams.

"Keep your eyes open if you get hit in the face," I was cautioned. But try to, even though one knows that the freezing effect will be gone in an instant!

When cars stopped, as they did often, many of the occupants piled out and danced round in circles or joined other tom-tomming groups. Several times our car became the center of such a circle singing "Americana, I love you," a Carnival tune.

"Is this Carnival?" I asked as I elbowed my way through the gay, singing crowds to my hotel near midnight. Someone nodded, and I got a squirt of perfume in the eye. Insistently, the drums still thudded outside when I went to sleep.

Next morning my room seemed to have more traces of Carnival than did the Rio Branco. Street cleaners had flushed and swept away confetti and serpentines.

But the celebration was not over. Again in the afternoon, like a tide, Carnival throngs began moving through the streets.

Exploring the city, I saw costumed people—rich and poor alike—everywhere in doorways and gardens, groups singing and jigging up and down the thoroughfares, and thousands congregated in the squares.

Streetcars were fantastically festooned with celebrants who pounded on drums, rattled tambourines, and clanged car bells as they rode toward centers of revelry. The youngest that I saw in festival dress was just over three months old, the oldest close to threescore years and ten.

RIO'S SIDEWALK BUILDERS FIND JIGSAW PUZZLES SIMPLE

The workman wearing a paper cement sack as a sunshade places the wooden pattern for the design. Others set white stones, about two inches in size, around it. Then the men remove the guide and fill in the vacant spaces with black stones. Sand is tamped into the crevices to hold the pieces firmly in place (page 288).

"Those are all cooks," said my chauffeur, pointing out a yellow-satin-dressed group of colored paraders, on one of our excursions. "Housewives have to prepare their meals or eat out, for the servants all vanish. It's Carnival for everybody."

Everybody except the police. Theirs was a tremendous task directing traffic. Black Marias, delightfully labeled "Assistencia Policial," were stationed in centers of activity, yet I saw only three in use.

"How do you like Carnival?" I asked a tired-looking policeman on a busy corner.

"Fine," was his answer, "but not here!"

On Tuesday again, frolic makers came early. Cars filled the Corso until six in the afternoon, when Rio Branco, Praça Mauá, and Praça Paris became solid seas of humanity. Later in the evening police somehow pushed paths through crowds to allow gigantic floats to pass.

Colossal constructions in papier-mâché and paper blossoms, mounted on long trucks drawn by several spans of mules, these floats were built by several long-established Carnival clubs. Some were elaborate allegories, others pictured early days in Rio. A giant Peace float displayed side by side the portraits of Presidents Roosevelt and Vargas. Carnival hit tunes were themes of others.

When the floats had passed, thousands went home or to their clubs; others stayed to dance in the streets. As outside, so in social organizations, places were packed. More than a hundred clubs held dances each night. At 1:30 in the morning I saw tired groups resting and sleeping on each others' shoulders while waiting for buses or trams. Carnival was nearly ended.

The throb of drums still echoed in my ears when friendly farewells were said and I stepped aboard a waiting airliner. Through its windows I had a final sweeping view of Rio's matchless panorama as we climbed high and flew southward.

OLD AND NEW IN PERSIA

In This Ancient Land Now Called Iran a Modern Sugar Factory Rears Its Head Near the Palace of Darius the Great

By the Baroness Ravensdale

JUST half a century after my father, Lord Curzon, had gone out to Persia as correspondent to the *Times*, of London, I satisfied a long-cherished desire to visit that ancient country.

How greatly the Persia I saw under the new name of Iran differed from the land my father had traversed so laboriously! In his two volumes he recorded customs and anecdotes now quickly fading in a tremendous wave of modernization.

Our travels began at Pahlevi, Iranian port on the Caspian Sea (map, page 329). In two American cars we drove through vaporous tropical jungle to Resht, where we slept in a newly opened modern hotel.

MOTORCAR REPLACING CARAVAN

Let me here quote from my father's book, *Persia and the Persian Question,* his reference to Resht in 1889 as an eye-opener to our different modes of travel:

"At Resht the traveler will form his first experience of that Persian wayfaring of whose pleasures and pains I shall have so much to say. Here he must decide between the only two practical methods of travel in that country: riding *chapar,* i.e., by Government post, or riding with his own animals and appointments by caravan. The former means rapid, if exhausting and sometimes painful progress; the latter is unutterably tedious, as the same animals must be used day after day."

We, on the contrary, departed next morning in admirable hired Dodge motorcars, and drove along the beautiful tropical seaboard of the Province of Mazanderan. This is the native province of His Imperial Majesty Riza Shah Pahlevi (page 330).

Some weeks later, on my way to Bandar Shah, I passed the valley of his birthplace, which adjoins the railway in its progress from that port to the capital via Firuzkuh. The men working on the tea and cotton plantations in this tract were paid a modest wage by the Shah. However, I wondered who would fill the huge new hotels pushing their heads into the air.

Here in this oriental setting appears an Iranian version of the south of France. Formal gardens descend to the seashore; flights of steps are protected by rampant lions, alternating with statues of undraped besilvered ladies clutching electric-light bulbs in their fingers.

The enjoyment of these Monte Carlo conditions of life cost at that time about $5 a day for room alone; thus far there had been no heavy booking.

HIGHWAY INTO THE HEART OF IRAN

We climbed the superb Chalus road, which ascends in incredible twists and turns up and through the amber Elburz Mountains. At last, passing over the crest, it emerges upon a magnificent plateau which seems to stretch into eternity.

There was no such road in the days of my father's visit. He went by way of Kazvin, which lies on the main route to Kermanshah and Khanaqin. And if we wonder what has caused these splendid roads to be made by the present Shah, one not insignificant factor was the arrival of the cheap motorcar during the war (page 351).

It will be remembered that this great country of Iran, as we are now invited to call it, much larger than France, Germany, and Italy combined, had lain practically dormant since the days of Shah Abbas. Reigning from 1586 to 1628, that greatest ruler of the Safavid Dynasty restored Iran to its fullest glory. He ensured the safety of the caravan routes, and along the hundreds of miles of dusty track decaying bridges and splendid caravanseries still testify to the encouragement that enlightened ruler gave to merchants and travelers passing through his country.

ROADS NOW SAFE TO TRAVEL

Iran today is going through another awakening under its present ruler. The endless dusty roads are safe again for travelers; bandits will not molest the unfortunate who, on one of the older roads, suffers the seventh puncture in a day from

Photograph by Lotte Errell from Pix

IRAN NO LONGER FROWNS ON EDUCATION FOR GIRLS

Schools for feminine students are increasing annually, for the old-fashioned idea of the Orient that women need no schooling is vanishing. Small, earnest girls wear checkerboard dresses.

the countless nails left behind by donkeys and horses that plod their way over the hand-raked surface.

All this means much to the Irani of today. Previously they had to "stay put" in the town or hamlet where they were born; now motorbuses whirl them across these limitless distances to all the big cities. They can see their country as it is progressing, read newspapers, study in schools, and become citizens of the world.

Their patience fortunately is limitless; for often the buses break down and all the occupants may have to sleep the night by the roadside, while the driver and innumerable assistants lie underneath the bonnet, banging away at repairs.

TEHRAN BURSTS UPON THE VIEW

On reaching the summit of the Elburz Mountains, we saw stretched away in front of us the limitless gray-brown plain until we hit Tehran. "Hit" is the word, since, curiously, like many Iranian cities, the capital suddenly bursts upon the horizon out of seemingly blank space.

The city is rapidly developing into a modern metropolis. Numerous old structures have been pulled down, among them the lovely tiled gateways leading out onto the great caravan roads to Kazvin, Meshed, and Qum.

Façades of many of the new buildings are copied from the Achaemenian palaces at Persepolis, with columns whose capitals are adorned with bull and lion heads.

The Gulistan Palace, belonging to the Kajar Dynasty (1794-1925) and containing the much disputed Peacock Throne, is admirably preserved.

This Peacock Throne was supposed to have been brought by Nadir Shah in 1739-40 from Delhi, but my father asserts that it was discovered in a broken and piecemeal

Photograph by Pasi from Three Lions

"SHOW YOUR PASSPORT—YOU'RE AT THE CITY LIMITS!"

Wayfarers must present credentials every time they enter or leave a large town in Iran. This system, although tedious at times, has improved public safety (page 355).

condition by Aga Mohammed Shah and that he had it made up into the throne of modern shape and style now standing in the Palace at Tehran (page 331).

CAMELS RELEGATED TO OUTSKIRTS

There is little of the old Persia in modern Tehran. The new streets teem with cars, trucks, buses, and power carriages. The trains of softly padding camels now remain on the outer fringes of the city. There are several modern hotels, and we stayed comfortably in the Hotel Firdausi.

In the newly erected House of Parliament there is a machine which taps out the names of all incoming members; also of those absent, on whom a fine is imposed.

For those who love old Persia, certain merchants still have lovely pots, enamels, and miniatures, and "antiquaries" in the city make one's mouth water with the beauty of their Luristan bronzes and Rayy pottery.

Some fine old palaces outside Tehran are now used as hospitals or military colleges. If they could speak, what tales of splendor those blue and green tiles and cut-glass inlays could relate of the beauties of silk and brocade and the revelries of a thousand and one nights.

Tehran's splendid racecourse has up-to-date stands and a royal pavilion. I hoped to see His Majesty attend the meeting, but at the last moment he canceled his visit, and the disappointed diplomats wore their full regalia in vain. The army owns most of the race horses and most of the gentlemen jockeys are army men.

VANISHING OF THE VEIL

His Majesty's daughter attended the races in modern dress. Banning of the *chuddar,* or veil, for women in Iran has

Photograph from Baroness Ravensdale

DONKEYS LEAD THE WAY TO A BAS-RELIEF PORTRAYAL OF PERSIA'S PAST

The carving, one of several depicting notable events in the days of the Sassanian kings, is cut from a stone cliff at Naksh-i-Rustum. Local inhabitants gave the place its name, which means "Pictures of Rustum." They mistakenly connected the carvings with exploits of their legendary hero, Rustum, immortalized in Matthew Arnold's stirring poem, *Sohrab and Rustum*.

Photograph by Pasi from Three Lions

DENTISTS PUT TEETH INTO THEIR ADVERTISING IN IRAN

A recent decree permits the use of only Persian characters in lettering public signs. As a result, pictures often appear with the lettering, so foreigners may recognize the type of business.

Drawn by C. E. Riddiford

LOCOMOTIVE WHISTLES BREAK THE STILLNESS OF THE LAND OF "ARABIAN NIGHTS"

From the Caspian Sea to the Persian Gulf, a new ribbon of steel bisects Iran. Completion of the costly line, which runs from Bandar Shah to Bandar Shahpur, has been one of the highlights in the campaign of Riza Shah Pahlevi to modernize this country where Omar Khayyam sang and Darius the Great led his armies. From Iraq and Turkey to India and Afghanistan, and from Soviet Russia to the Arabian Sea, new industrial and engineering projects rub shoulders with ancient ruins. Centuries-old camel trails are now replaced by motor roads. The author began her travels at Pahlevi on the Caspian Sea (page 325).

brightened the color of crowds. The long black enveloping veils of the women, which made even a race-track crowd seem somber, have given way to colorful European dresses and hats (pages 334-5).

Because army maneuvers were going on near Demavend when I first reached Tehran, no cars were available for touring. Most had already been commandeered by the army, and the rest were in safekeeping.

Fortunately, His Majesty is aware of the wealth of ancient buildings and mosques his country possesses. Unlike many other orientals, who so often seem not to care to preserve their beautiful monuments, he has started a survey of such buildings and, at considerable sacrifice, money is being liberally allocated for the preservation of these exquisite relics.

A few miles beyond the paved streets of Tehran one forgets the rush of modernization going on within the city, and the dust of animal caravans dims the eyes as one reaches the ancient capital of Rayy (Rhages), where Harun-al-Rashid was born. How many civilizations its ruins

Photograph by Pasi from Three Lions

ADMIRERS OF RIZA SHAH PAHLEVI WOVE HIS LIKENESS INTO THIS CURTAIN

Eighteen years ago Iran's ruler marched into Tehran with 2,500 soldiers and took over the government. Five years later he was crowned Shah. He placed the crown upon his head with his own hands, as did Napoleon.

conceal can best be told by Dr. Erich F. Schmidt, successor to Professor Ernst Emil Herzfeld at Persepolis.*

THE ANCIENT SETTING IS UNCHANGED

Away to the left, dwarfing altogether the distance between, towers the mighty cone of Demavend, a mountain which signifies as much to the Persian as Fujisan to the Japanese.

Though the chimneys of His Majesty's cement factory near by testify to the huge strides being made in the industries of the country, nothing can change the glory of the setting sun, turning that eternal snow-capped peak a blush rose and covering the dusty plain with a carpet of gold, across which the tinkle of camel bells sends a message charged with the ancient history of this magnificent country.†

Looking down on that golden radiance from the old fort of Rayy, I knew that the landscape of Iran, unique unto itself, had eaten into my very soul.

The 300-odd miles from Tehran to Isfahan afford a perfect example of this endless dusty amber plain, bounded by scraggy mountain ranges that turn burnt sienna, orange, and vermilion as the sun plays on them throughout the burning day. There is little that is tangible by which I can describe this; therein lies its wonder.

A grim salt lake like a palsied hand stretches in front of the traveler before he reaches Qum, one of the sacred cities of the Shia faith. There in the sanctuary lies the body of Fatima, the sister of the Eighth Imam, who himself lies buried at Meshed, the first sacred city of Iran (Plates I, II, III, VII, and VIII). She died A. D. 816. Visitors are now permitted to go inside these holy precincts at Qum to gaze at art treasures in a newly opened museum. Two colorful minarets and a golden dome blaze endlessly into the pitiless sky.

Unique sweetmeats adorned many bazaar

* See, in the National Geographic Magazine, "Exploring the Secrets of Persepolis," by Charles Breasted, October, 1933, and "Citroën Trans-Asiatic Expedition Reaches Kashmir: Successfully Crosses Syria, Iraq, Persia, and Afghanistan to Arrive at the Pamir," by Maynard Owen Williams, October, 1931.

† See "Modern Persia and Its Capital; and an Account of an Ascent of Mount Demavend, the Persian Olympus," by F. L. Bird, National Geographic Magazine, April, 1921.

Photograph by Maynard Owen Williams

A MORE RECENT THRONE OBSCURES THE JEWELED PEACOCK DAIS IN GULISTAN PALACE

Scholars believe the graceful structure behind the jeweled chair contains parts of the famous Mogul royal seat at Delhi, which was carried to Persia in 1739 by Nadir Shah (page 326). Across the back two carved peacocks spread their glittering tails, inlaid with rubies, emeralds, and pearls. At the top shines a revolving sun of diamonds. Dragons of green enamel support two steps by which former monarchs ascended to the platform, there to sit cross-legged in oriental fashion.

Photograph by Alice Schalek

A THOUSAND YEARS BEFORE THE BIRTH OF CHRIST ASSYRIAN CARAVANS PUSHED INTO ANCIENT HAMADAN

The famous rug center at the foot of Alwand Mountain, today a bustling city, lies midway between Tehran and Baghdad. Here the Medes stored their plunder when they captured Nineveh, and Cyrus later kept the fabulous wealth seized from Croesus. Beneath a domed mausoleum in the heart of the city stand the legendary tombs of Esther and Mordecai.

Photograph by Maynard Owen Williams

CALLERS PASS THROUGH A PERSIAN GARDEN TO ENTER TEHRAN'S MUNICIPAL BUILDING

Ponds, fountains, and flower beds stud Sepah Square, once known as the Square of Cannons, in the heart of Iran's capital.

© AP by Errell from Black Star

VEILED WOMAN—OLD STYLE

When the wearer did not wish to be recognized, she pulled down the horsehair visor, through which she could peek. Now she is forbidden to veil her face.

stalls, and even the flies did not deter me from buying a delicious honey treacle biscuit. When we stopped for a picnic lunch by the roadside, the Iranian country folk tendered us fine hospitality. They brought out their Persian rugs and spread them on the ground for the visitor to rest on while they offered eggs and melons for practically nothing. There is restful charm, after scores of miles of grim desert, in a tiny oasis with running water in a deserted Persian garden, with little children peering from open doors.

Unforgettable is the approach to Isfahan. Out of the earth-colored atmosphere the Zinda River winds slowly along the wide valley, creeping through groves of whispering trees, and then suddenly there flash upon the gaze the heavenly blue domes, marvelously shaped, exquisitely tinted (Plate VI). No other city of the East ever had more colorful signals to lure the traveler to her portals.

The fluttering avenue called "Chahar Bagh" (The Four Gardens), planted by Shah Abbas, is the Constitution Hill of Isfahan. The young bloods of Iran mooch amiably up the gentle slope, passing the splendid blue-tiled Madrasah (or sacred college) of the 18th century, till they reach the Maidan-i-Shah, a magnificent plaza 560 yards long by 174 wide.

Our hotel in Isfahan, again called Firdausi, gave us excellent food and attendance. My room opened onto a balcony overlooking the Chahar Bagh.

At dawn, with a rosy blush warming the dome of the adjoining Madrasah, I crept out to look down on the long lines of camels padding slowly past, their haunting bells droning through the silence, and only the occasional raucous yells of their keepers breaking the spell.

The delicate Ali Kapi, or palace for public audiences, looks serenely down on the Maidan-i-Shah, the scene of the ancient games of polo.* Now only the stone goal

* See series of paintings, "Faces and Fashions of Asia's Changeless Tribes," by Alexandre Iacovleff, NATIONAL GEOGRAPHIC MAGAZINE, January, 1936.

posts testify to what took place there; for, alas, a pond and modern flower beds surrounded by iron railings transform one of the noblest city squares in the world. The Government offices now surround the graceful Chahel Situn, or "Hall of Forty Columns."

A charming Governor gave us of his unbounded hospitality in a tea party with delightful Persian sweetmeats and cakes fit to ruin the digestion forever. He took pleasure in introducing me to men who remembered my father. I even met the son of the noble with whom my father had stayed in Isfahan.

Another charming Iranian gave us a sumptuous Persian meal one night in his genuine old Persian house. Dish after dish of spices, raisins, and sweets followed on luscious rice mixed with meat and fowl, tender and soft as cotton wool.

© AP by Errell from Black Star

TODAY, VISOR AND VEIL GONE, WOMEN WEAR EUROPEAN DRESS

Here the visor is up, the way it was usually worn. The young woman has on the black cloth garment that envelops her from head to foot.

Again, the covered-in bazaars afford limitless delights, not only in purchases but in the bustling crowds.

Three points of splendor hold the eye in Isfahan. One is the Masjid-i-Shah, built by Shah Abbas I with 18 million bricks in the early 1600's (page 336). No richer blue could be imagined than the tiles of the dome and the graceful minarets.

The Masjid-i-Shaik Luft Allah has rare designs of curving branches and flowers on its resplendent dome. Then, lastly, the venerable Masjid-i-Jumeh, or Friday mosque, holds such intricate and delicate brickwork on its domes and archways that women could find eternally new patterns for their cross-stitch samplers.

A SUGAR FACTORY IN PERSEPOLIS

Leaving that sublime city of running waters and green trees, I next reached Persepolis. Looking out on the limitless brown plain from the capital of the Achaemenian Empire, I saw not far away a large sugar factory rearing up its mighty modern head, yet another sign of change.

In spite of ancient and modern in such close proximity, the view from the great terrace today is even more superb than it

Photograph by Arthur Upham Pope

WALLS OF ALABASTER AND FAÏENCE ARE MIRRORED IN THE WATERS OF A COURTYARD POOL

Moslems gather in the Masjid-i-Shah, or royal mosque, at Isfahan for devotions. The building, erected by Shah Abbas I in the seventeenth century, is faced with brilliantly enameled tiles. It is on the south side of the great square (Plate VI and page 335).

was in the time of Darius I, or of his son Xerxes; for the massive outer wall protecting the palaces is gone, and the battered columns and the magnificent double stairways stand open to the winds of heaven.

One of the resident young archeologists showed me to my dismay my father's scratched signature, "G. N. Curzon, 1899," in one of the windows of Darius's Palace. But the name is in distinguished company; on the giant winged bulls at the doorway of Xerxes' Palace are the signatures of many well-known historians and explorers of the 19th century who have passed that way.

On the ride to Naksh-i-Rustum, near Persepolis, I was fortunate in meeting a small migration of tribes moving slowly down with all their flocks to the plains for autumn and winter pasturage. Along with the children, their black cloth tents were piled high on the camels. These simple people were coming down from the upland valleys where they had spent the hot months. The Shah, however, wishes to discourage these yearly migrations and so keep the tribes settled and unarmed.

We went onward to Shiraz. Its beauty lies for me in the peep of it from the police post up the mountainside, with the domes quivering like jewels in the setting sun.

It is worth returning to Tehran by another route to appreciate the delicacy of the minaret and doorway of Natanz where sapphire and turquoise blue twine their vividness in inscriptions and flowerlike patternings. Lace stuccowork in the fawn-colored brick mosque of Ardistan forms a rare lily design. But I did not have time to visit

Photograph by Pasi from Three Lions

THROUGH A LOOP TUNNEL, IRAN'S RAILWAY PUSHES INTO THE DIZ RIVER VALLEY

The two entrances to the curved underground route are not far apart, but at different levels. Since this photograph was made, the entire line which links the Caspian Sea and the Persian Gulf has been completed. The line, 865 miles long, crosses two mountain ranges and a desert.

the ancient city of Yezd where the Zoroastrians still have their fire temples. Incidentally, two interesting fire altars are still to be seen just beyond the Naksh-i-Rustum rock reliefs (page 328).

The village of Yezd-i-Khast is an interesting sight in its forbidding grimness, jutting out over the new road with its haunted empty-window eyes (page 350).

CAR TROUBLE MEANS SLEEPING OUT

Returning beyond Qum, late at night, we found one of our car loads, sent off earlier in the day for Tehran, in trouble by the roadside. After a half dozen punctures, the passengers had given up for the night, as the chauffeur finally confessed that none of his tubes would fit.

I next motored up north again to the Caspian, viewing the incredible structure of the Shah's railway creeping slowly through this stupendous mountain gorge. The Trans-Iranian Railway, about 865 miles long, now extends all the way from the Caspian Sea to Tehran and on to the Persian Gulf. It took ten years to build. Trains began to operate on the whole length of the line in December, 1938.

Several stations before Bandar Shah my car was placed on a truck, and the train slowly chugged up through His Majesty's cotton fields, where the workers were plucking and collecting the fluffy tufts.

At the straggling little portlet of Bandar Shah a charming Swedish couple entertained us at dinner in their home. Our host was the railroad's chief engineer. They were preparing for the visit of His Majesty to inspect the progress of his precious railway. The station waiting room

was allocated to us for the night, and how thankful we were for our sleeping bags that softened hard boards and tables! The French Minister arrived late that night by car and pitched camp near Asterabad.

Next morning when we picked him up to go with us to Gunbad-i-Qabus, he told us tales of an evening's shoot by flashlight, when he had killed deer, jackal, pig, and porcupine in the low surrounding scrub. We tasted of all these animals later when, exhausted and famished after our long day's outing, we had supper with him.

We unfortunately collected a guide who said he could take us safely across the limitless Turkoman Steppes to the Tomb Tower of Gunbad-i-Qabus, but whose sense of direction proved to be nil. He rushed us madly into bogs and quicksands; but I assumed, after careering blindly about for hours, that that glorious brick needle must surely beckon us very soon from 10 or 15 miles away. At last, sure enough, the noble tower showed itself in the glittering afternoon sunlight, alone and majestic, an arrow of dainty fawn-colored bricks, dexterously laid, clear-cut against the distant snow-capped mountains.

HOSTAGES HELD IN A MAUSOLEUM

A pathetic group of old men were huddled in this superb mausoleum, temporarily a squalid prison, for these venerable beings were being held as hostages for their sons who had deserted across the border. The Government is making an effort to civilize the Turkomans, bring their boys into schools, teach them sports, and give them a sense of responsibility.

Dotted over the plain are still to be seen some Turkoman felt tents with their interior walls beautifully embroidered in colored wools. I fear it will not be long before these relics of the nomad tribes on these limitless steppes are lost forever. As I have already mentioned, the policy of today is to check the migrations of these wandering creatures (who for centuries have roamed the spaces with only heaven to approve their nightly resting place), and settle them in permanent mud brick houses.

From Tehran to Meshed is about 550 miles, but telephone messages ahead can procure the traveler a bedroom in one of the many garages run by the Russians who are to be found in Samnan, Damghan, and Shahrud. In none of these towns did we receive anything but the most courteous of welcomes and the fullest facilities for seeing the sights. Buses stop at all the garages. Many are crammed with pilgrims for Meshed.

One can procure a perfectly good bedroom with a brass bedstead and a hand mirror with pink roses surrounding it. If desired, a toothbrush and hairbrush lie ready on the table. Oleographs of His Majesty the Shah adorn the walls.

In one garage the bedclothes struck me as looking slightly "used," and the garage owner, only too anxious to accommodate, suggested that I use the cotton curtains, which had just been newly washed and hung.

HORSE TRAVEL WAS WEARISOME

I took about four days motoring up to Meshed, stopping often to examine the monuments. By traveling all day, one can make the journey in two days. Four English miles go to a Persian *farsakh,* but my father says: "The Khurasan farsakh is famed beyond all others for its odious and seemingly inexhaustible length—a compliment in reality to the funereal monotony of the road."

In his day the route was divided into 24 stages, the posthouses averaging about 23 miles apart. My father completed the journey in the opposite direction, from Meshed to Tehran, in nine days, averaging 60 miles a day, and he approached Meshed via the northern route from the Caspian. Though fast riding, according to him, was an accomplishment for which the Persians were famous, his miserable steeds could never have justified this boast. He writes:

"The best-known characteristic of the Persian post horse is his incurable predisposition to tumble. I could not make out that either a tight rein or a slack rein had very much to do with the occurrence of this phenomenon, and I ended by concluding that the Persian post horse has a certain regulation number of falls in the year, which may be distributed either by accident or as he pleases, but the full tale of which some hidden law of necessity compels him to complete."

The road to Meshed abounds in exquisite buildings. Bustam, surrounded by snow-capped mountains, holds concealed in lush green trees venerable minarets and mosques, like colossal nuggets of turquoise and sapphire. Never did dark and pale blues rush more intoxicatingly after each other in such a wealth of tracery around doorways and arches.

GILDED DOMES AGAINST AN AZURE SKY

© National Geographic Society Kodachrome by Stephen H. Nyman

COPPER OVERLAID WITH GOLD ENCASES DOME AND MINARET OF IMAM RIZA SHRINE

From a base of alabaster rise the walls and portals of multicolored tiles in the Holy City of Meshed. Each year 100,000 Shia Moslem pilgrims from all parts of Iran (formerly Persia) kneel at the tomb of their spiritual leader, who died a thousand years ago. He was a martyr, they believe, who was poisoned when he was about to become caliph, or ruler. Also buried here is Harun-al-Rashid, hero of the *Arabian Nights*.

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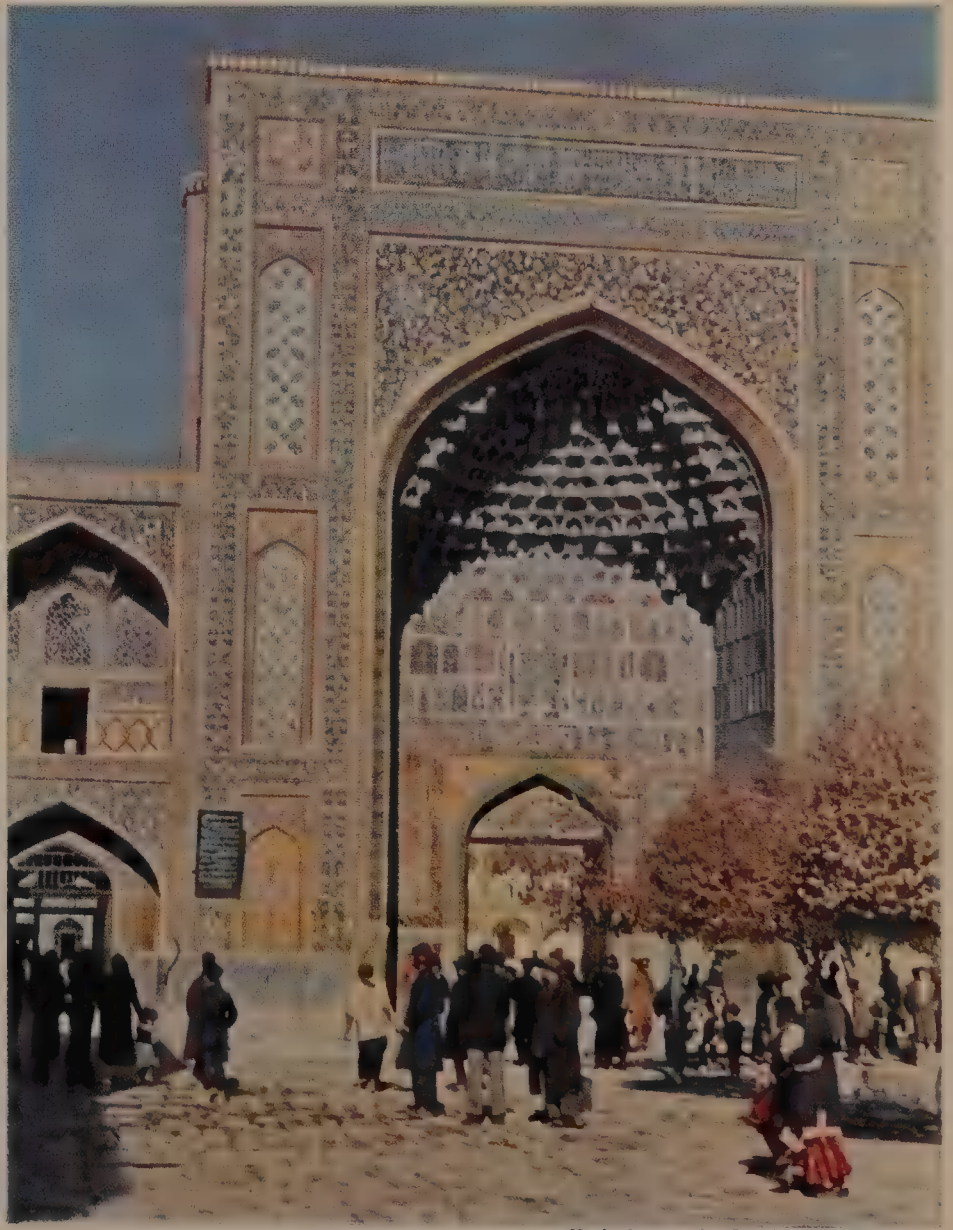
"MAY ALLAH ACCEPT HER WORK"

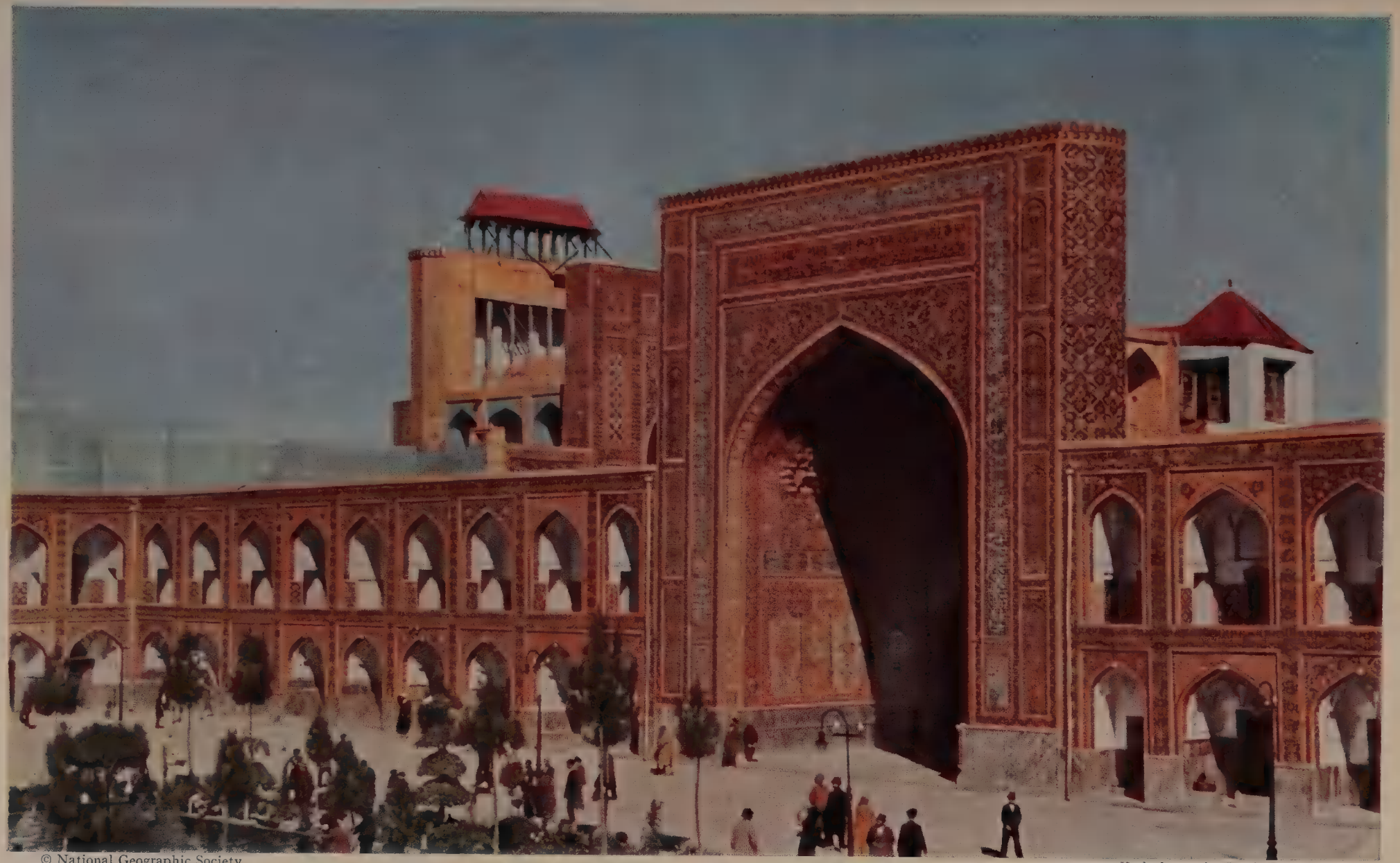
So reads a part of the inscription on this minaret and mosque in Meshed. The buildings were erected by a woman, the noble Gawhar Shad, wife of a shah and mother of two famous sons, an astronomer and a painter (Plate VIII).



Kodachromes by Stephen H. Nyman

PILGRIMS REACH THE PORTAL TO MESHED'S GREAT COURT

Exquisite tilework ornaments this entrance to the shrine (Plate I). Shia Moslems attain the ambition of their life when they reach the Holy City. One shah journeyed here on foot from his capital, 500 miles away.



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GIFTS FROM THOUSANDS OF PILGRIMS HELPED ERECT MESHED'S IMPOSING NEW COURT OF IMAM RIZA

Grandiose inscriptions border the tiled gate, one of the outer entrances. In recent years much of the shrine's income, about $100,000 annually, has been devoted to civic betterment. Modern housing projects are under way and an up-to-date hospital has been built.

NEWLY DYED YARN, SPREAD OVER POLES, DRIES IN THE SUN AT TEHRAN

Natural dyes, extracted by old-time methods from roots, leaves, flowers, and certain animal products, still are used in Iran. Only in a few localities have synthetic dyes been introduced.

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Kodachromes by Stephen H. Nyman

SECRETS OF THE DYE POT GIVE TO IRAN RUGS THEIR LUSTER

After the wool has been washed, it is dipped into one or more vats to attain the proper shade. Then it is hung up to drip and afterwards plunged into cold water.

PERSIAN RUGS, NEW AND OLD, RECEIVE AN ICY BATH AT RAYY

At the foot of a rocky hillside, 4,000 feet above sea level, fabrics brought from Tehran are washed in a bubbling spring. Rugmakers say the mineral content of the water imparts a sheen.

© National Geographic Society Kodachromes by Stephen H. Nyman

PRECIOUS RUGS STAIN THE CLEAR SPRING WATER IN NATURE'S WASHTUB

First they are thoroughly shaken at the edge of the spring, and then thrown in. The barefooted workmen stamp and rub them vigorously.

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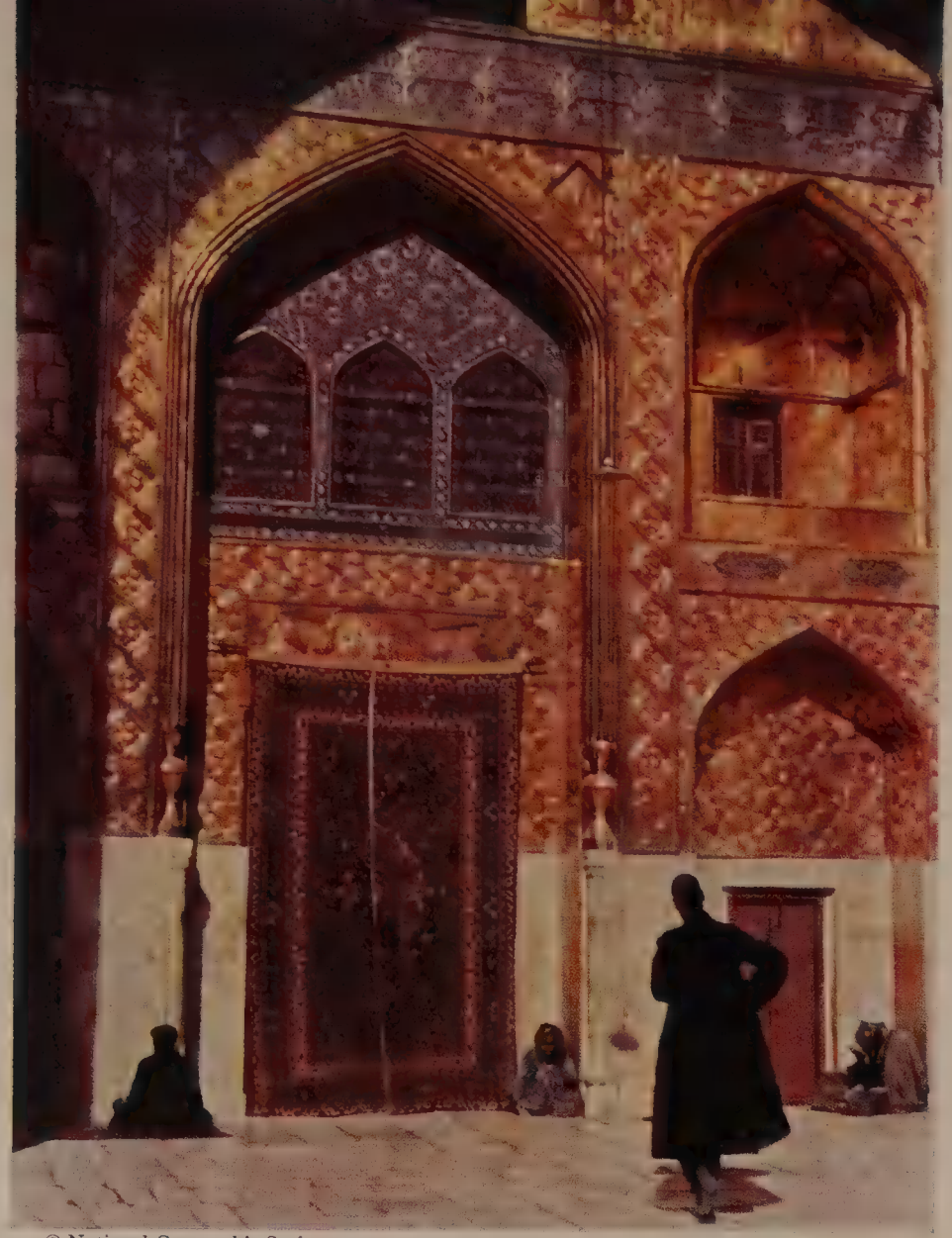
Kodachrome by Stephen H. Nyman

COURT AND BLUE-TILED DOME RECALL THE VANISHED GLORY OF ISFAHAN, ONCE "HALF THE WORLD" TO EVERY PERSIAN

Modern landscape engineers have built a pool and planted shrubbery (left) where polo players once rode furiously. The game originated in Iran. Restored is the Mosque of Sheik Lutf Allah (right), built more than three centuries ago when this capital was new. Stunted sycamores and plane trees stand before the two-story arcades, with recessed arches, which flank the courtyard. Beyond the buildings stretch bazaars, where buyers may walk for more than three miles under cover.



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SHOES REMOVED, A SHIA MOSLEM APPROACHES THE SHRINE

A halved rug of rare beauty covers an entrance to the tomb of Imam Riza. The walls are of cream-colored alabaster, gold plates, and tiling.

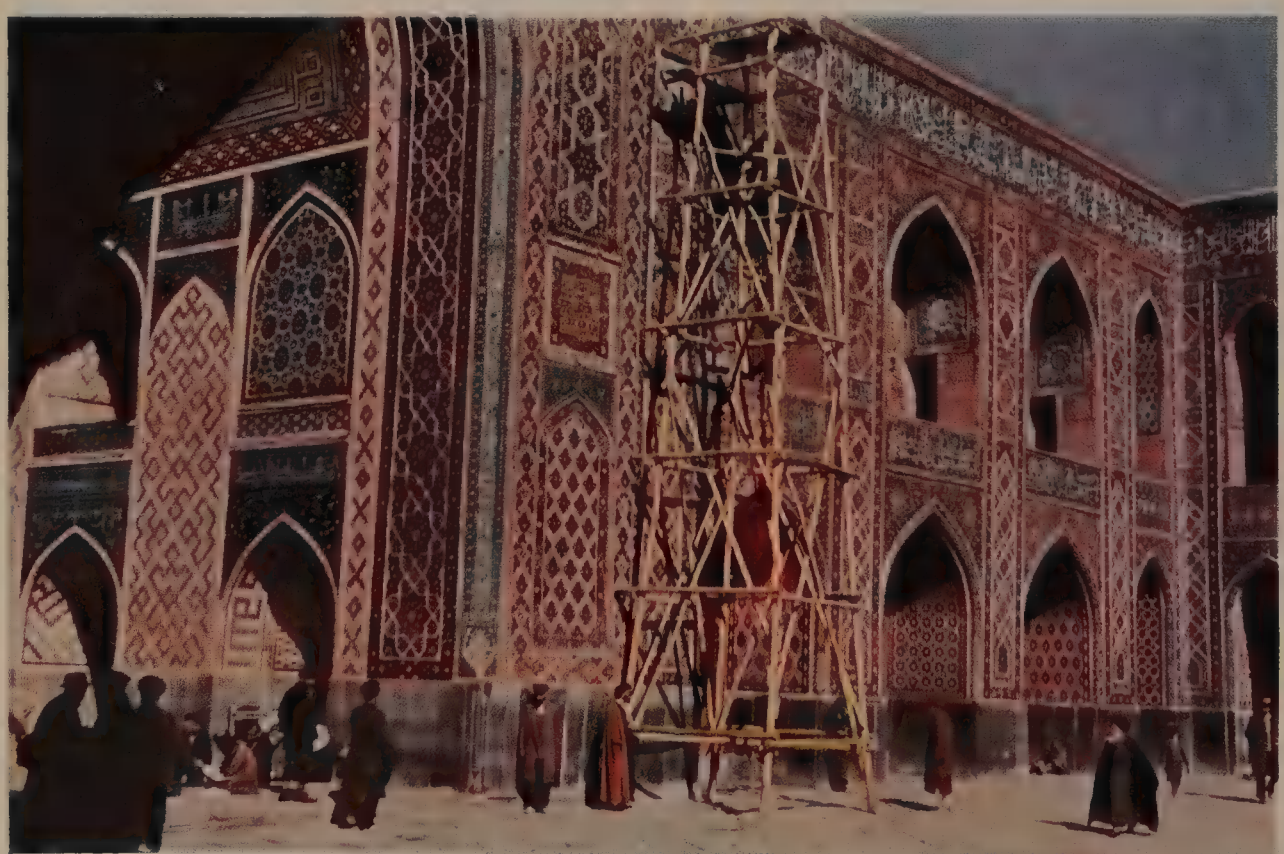
Kodachromes by Stephen H. Nyman

PILGRIMS REVERENTLY BOW THEIR HEADS IN THE GREAT COURT

After they visit the tomb they earn the title of Meshidi and may be buried in consecrated soil within the shadow of the Mosque of Imam Riza (Plate I).

NEAR BUSTAM'S OLD ROUND TOWER LIES THE SHRINE OF AN ANIMAL LOVER

Legend tells that Bayazid, buried here, found an ant in his luggage while traveling. The dervish immediately went back to his starting place to return the ant to its home.



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Kodachromes by Stephen H. Nyman

WORKMEN REPAIR THE TILE AND ALABASTER MOSQUE OF GAWHAR SHAD

When the revered builder, wife of Shah Rukh (Plate II), came to Meshed to inspect the structure early in the 15th century, she brought with her 200 beautiful women attendants. All of them were married to students in a college she had established in the Holy City.

Damghan has an exquisite minaret, and also the tomb tower of the Forty Daughters (A. D. 1054) with a bewilderingly beautiful brick inscription. At Mihr is one of the finest of all Shah Abbas's caravanseries. In the village one can buy delicious hot partridges, freshly cooked, and sold for a few pence in a sandwich of soft bread.

Near Sabzawar is a graceful minaret (A. D. 1111), one of the finest in Iran. The recently repaired tomb of Omar Khayyam at Nishapur tries unsuccessfully to compete with the beauty of the tomb of the brother of Imam Riza, alongside it.

Since Meshed is the most sacred city of Persia, I desired to go there, if only to look on the exterior of the dome of Imam Riza's tomb (Plate I), and peep from afar at the polychrome exterior of the Gawhar Shad Mosque, unsurpassed anywhere else in the country (Plates II and VIII).

Black-browed Afghans, wild Baluchis, Indian traders, Caucasian devotees, Turks, Tatars, and Mongols make a bewildering kaleidoscope as they pour into Meshed.

On the approach to the city from the mountain heights, piles of small pebbles by the roadside testify to the first glimpse the pilgrims have had of their "Mecca."

Originally I had not the faintest hope of entering the sacred shrine; up to the time of this visit (1935) only a limited few Infidels, disguised, had succeeded at the risk of their lives. Everywhere, however, the Shah is slowly breaking down fanaticism, and in all cities one now can visit the mosques with a guide. Qum and Meshed are the sacred Shia strongholds and were the last to succumb.

FAKE MULLAHS OUSTED

The power of the mullahs is slowly being broken. Many so-called mullahs had no right to bear the name, or to wear the green turban as descendants of the Prophet, and so batten on the masses. His Majesty now demands a stiff and honorable examination of all wishing to become or remain mullahs.

Some weeks before I reached Meshed an unpleasant episode had complicated the situation as regards Imam Riza's shrine. A certain mullah had gravely inflamed the pilgrims by attacking all forms of modernization, such as the abandonment of the chuddar, the drinking of wine, and the wearing of European clothes.

Pilgrims were requested to leave the mosque precincts. Misunderstanding the situation, and imagining the sacred precincts were a sanctuary against all trouble, they remained and got involved in a wildly inflammable group which raided the shops in the *Bast,** breaking them up and tearing the European clothes off the shopkeepers.

The Governor rushed in Baluchi troops with machine guns, and many were killed. The true figures will never be known, as lorries were hurried down to bury all dead, and it is better to ask no questions.

SEEKING ACCESS TO HOLY OF HOLIES

This was all the more reason, one would think, for my not being allowed to enter the shrine when I got to Meshed; but two of my friends from the British Legation in Tehran had been conducted through it under the protection of the Governor before my arrival and this raised my hopes considerably.

My visit to His Excellency the Governor of Khurasan was vital. How different from that of my father, who said: "Our conversation was not of surpassing interest, as the Governor contented himself with civil and conventional replies. I asked him if he thought railways were likely to come to Persia. 'If God be willing, yes,' was the somewhat ambiguous rejoinder."

My father was merely conducted over the roofs of the bazaars to the spot where he could see the sacred buildings, and he claimed the modest distinction of being the first English Member of Parliament to enter the walls of Meshed.

Soon after my arrival the Governor graciously sent for me with my friends about 8:30 a. m. My companions sat completely mute, while for twenty minutes I discussed with His Excellency in French the possibilities of a police escort for the four men of our party who were leaving for Afghanistan at dawn next day. He explained to me the dangers of the road were very great, since a notorious bandit who had held up and robbed several Britishers had not yet been caught. After an endless argument on this subject, we discovered the bandit was on another road.

How was I to get to the prime question haunting my mind? Luckily, the acting British consul chimed in, remarking,

* Not only the buildings of the shrine, but also an area reaching to about a hundred yards beyond its gates on each side, are considered sanctuary *(bast)*. In former times, criminals who succeeded in reaching this area could live there in safety. It still contains lodgings and bazaars.

Photograph by Ewing Galloway

NO LONGER A NOMAD, A LITTLE KURD GOES TO SCHOOL

Within the last decade, Riza Shah Pahlevi, ruler of Iran, has burned the tents of Kurdish wanderers and settled their owners in villages. Banditry has been greatly reduced. Instruction in this outdoor school was principally religious, but a system of state education is being built up rapidly.

"Lady Ravensdale and her friends are all earnest pilgrims."

PERMISSION TO VISIT THE SHRINE

Even then the Governor shied from the subject and continued about the police escort, but before my departure he surprisingly came back to it and said he would arrange for us to go through the shrine that afternoon. My woman companion and I must go disguised in the black chuddar, but he could not attempt to disguise six-foot Englishmen as Turkish pilgrims.

Since time is often of little importance to the Iranian, the supposition was that the expedition would take place in the late afternoon. My companion and I were to rehearse the wearing of our chuddars at 2 p. m. with two charming Iranian ladies who were to lend us two of theirs and accompany us through the shrine as guides. On entering the consulate for this rehearsal, I found the shrine official waiting to conduct us to the mosque immediately. I quickly sent for the Englishmen, while we went through such hasty efforts at keeping the chuddars on our heads as time would permit.

We four ladies went in my car to the entrance of the shrine, while the men were to follow in a cab. That wait outside the Bast was nerve-racking. A policeman kept asking our two Persian ladies why we were hovering about. I expected discovery and a row any moment, for spies and devotees were always hanging around the outer fringe of the mosque and pushing away any foreigners with cameras or impertinent peering eyes.

I thought we should never get to the other side of the heavy chains that hang across the Bast gateways. At last our men appeared with the head official, and we moved nervously through the Bast into the great tiled courtyard.

I had unbuttoned my shoes, ready to shed them quickly. I feared my chuddar would

slip, and I was in an agony lest I should lose my little Iranian lady. She was tiny, and the crowds were terrific, swaying and surging in every direction. These two admirable ladies propelled us through the great gold doorway which guards the shrine of Imam Riza, and we deposited our shoes with hundreds of others in a lobby entirely used for that purpose.

Photograph by Pasi from Three Lions

IRANIANS STILL COUNT ON AN ABACUS

The old-fashioned "calculator" contrasts strangely with its surroundings in modern hotels, restaurants, and offices of Tehran. Usually the first row of counters, which are strung on wires, stands for units; the second for tens, and so on. Such primitive "adding machines" still are widely used.

EXCITED ZEALOTS FORM A SEETHING MASS

By that time we had missed the men of our party, and we four women were alone in this swaying, struggling mass of pilgrims, all surging toward the innermost shrine. It was about the most terrifying experience of my life.

Picture a succession of chambers decorated in cut glass like the glittering facets of millions of diamonds. These rooms were packed with a shrieking mob of devout worshipers kissing the exquisite silver doors leading toward the shrine, murmuring verses of the Koran, kneeling in scores, and bumping their heads on the lovely alabaster floors in a frenzy of devotion.

All this took place long before we got to the Imam's tomb. When we arrived there, we slowly made a procession around the sarcophagus.

That innermost chamber, of glorious cut glass with floral designs in gold, was a seething mass of excited zealots, struggling and fighting to get near the great silver cage in which the coffin lies, handing their children over the heads of the crowd to kiss the bars or tie on a tiny piece of cloth.

Though I suppose that no devout pilgrims ever look up at the unbelievable tiles in the different domes and adjacent chambers, I meant to see as much as my frightened eyes could take in.

Having completed this alarming progress around the shrine minus any protection,

Photograph by W. Robert Moore

LIKE A GIANT SHIP OF STONE STRANDED IN A DRY RIVER BED, YEZD-I-KHAST RISES HIGH ABOVE A ROCKY GORGE

"God Willed It" is the meaning of the name of this remote town south of Isfahan, to which a single drawbridge permits entrance. Zeki Khan, with his troops, visited it in 1779. He became angered when the townspeople refused to comply with all his demands. For revenge he ordered his soldiers to hurl the leading citizens down over the cliffs to their death. After 18 had thus perished, his men rebelled. They cut the ropes of his tent, which collapsed upon him, and the villagers then rushed in and killed him.

Photograph by Wilber

THROUGH THE KHURASAN WILDERNESS A NEW MOTOR ROAD WINDS SOUTHWARD FROM MESHED

'Amaq tribesmen, Turks, and Baluchis dwell in the wild, rugged country in this northeasterly province. Gypsies also wander from one fertile spot to another.

Photograph by Alice Schalek

GIANT FIGURES OF CHOSROES II KEEP CENTURIES-OLD VIGIL IN A MAN-MADE GROTTO

Artists of the Sassanian monarch carved statues in the large recess, hewn from solid rock, at "Grottoes of the Garden," near Kermanshah. Winged figures resembling angels, surmounting the arch, have been restored. On the back wall of the alcove a ledge separates two panels. On the upper panel deities present garlands to the king (central figure). Below, Chosroes II, who reigned thirteen centuries ago, rides "Black as the Night," his favorite charger (page 354).

we emerged into a neighboring chamber. Shrine officials by that time had discovered our defection and hustled us into another room where the males of our party were waiting to commence with us the walk around the Imam's tomb. Since we had got through safely once, the temptation was too great not to repeat the experience and have yet another glimpse of the chamber.

This time we had several shrine officials and a chanter, who murmured verses of the Koran in our peregrination around the tomb. I noticed some superb jewels, swords, diamond aigrettes, and scabbards hung over the Imam's tomb, offerings from previous rulers in Persia. The supposed burial place of Harun-al-Rashid in the same area has faded into insignificance by the side of the Eighth Imam.

Forever indelibly stamped on my mind will be the agonized look of about eight mullahs, kneeling by the wall, reading their Korans. They saw our little group filing through; their looks were not of murder or hatred, but of pain, as if we had done some injury to their innermost souls that could not be repaired. They had the appearance of cowed and beaten men.

One of our Englishmen, knowing Persian, heard many times muttered, "Foreigners," "Infidels."

HOUR OF EVENING PRAYER

We were permitted to gaze all too briefly on the beautiful polychrome façade of the Gawhar Shad Mosque, built in 1418 by the wife of Shah Rukh (Plates II and VIII). In a private room looking full onto the burnished gold dome of the Imam's shrine, we were shown Korans from the Treasury that made the spirit weak for sheer beauty and delicacy of design.

As we left the mosque, the hour of evening prayer was approaching, and the great drums and gongs were thundering out the invitation to prayer. The pilgrims were kneeling in thousands or performing their ablutions in the sacred fountains. A sinking sun caught the

Photograph by Alice Schalek

HIGH ON THE ROCKY WALL AN ANCIENT EGOTIST RECORDED HIS EXPLOITS

Darius the Great ordered his sculptors to carve this group on the face of Bisitun mountain, near Kermanshah, The monarch is shown passing sentence on ten captive kings. When deciphering the inscriptions a century ago, Sir Henry Rawlinson, then a young British army officer, found the key to the old Eastern languages (page 354).

Photograph by Baroness Ravensdale

WALLS OF TAK-I-BOSTAN RECORD A SIXTH-CENTURY BOAR HUNT

On an inner side of the arched grotto of Chosroes II (page 352) sculptors carved the vivid scene. Beaters, mounted upon elephants, drive frenzied boars toward the royal barge where the king awaits them, armed with bow and arrows. In adjoining boats, girls play harps to amuse the king.

great gold doorways in a fiery glow as we hurried out. The thrill was over! Today visitors may readily pass through those splendid courts and chambers, but they will never know what others experienced in the days when Meshed was still an unapproachable stronghold of the Shia faith.

At 4 o'clock the next morning I rose to see my four companions off to Afghanistan. The police escort dutifully turned up at 5, jammed so tightly in a small car that they would need minutes to unload before the attack of the bandits.

A prodigious argument was going on with the head officer, and it developed that he was looking for Lady Ravensdale to protect. I assured him I had only an overcoat concealing my nightgown and had no intention of entering Afghanistan. He needs must go to the telephone and call the Governor to rectify this error.

After 25 minutes' delay my friends in the two cars disappeared in a cloud of dust. The head officer finally reappeared with yet another soldier buttoning on his uniform, and they leisurely followed the cars they were assigned to guard at all costs.

When I left Tehran, the first snows were capping the mountains that protect the city, and I traveled via Kazvin, Hamadan, and Kermanshah.

At Bisitun, high up on the mountain scarp, I gazed on the famous inscription of Darius the Great in the Babylonian, Elamite, and Old Persian characters. This inscription, it will be remembered, gave the key to Sir Henry Rawlinson for deciphering the cuneiform inscriptions. At Tak-i-Bostan I looked at the wonderful rock carvings of Shapur II and III of the 4th century. The superb workmanship displayed in the boar hunt in the grotto of Chosroes II is a delight to all (page 352 and above.)

These were my last archeological memories of Persia, but still we had to battle with a few more police posts. I am fully

aware of the immense service these police posts in every town have rendered in the rounding up of bandits, deserters, and objectionable characters, but I found even my insatiable zeal for travel melting on arrival at the sixth or seventh police post of the day, when the commandant looked at my passport upside down and asked me my mother's birthday and the Christian name of my father. Picture a motorbus tour, 70 or 80 strong, being held up like that. They would be there for hours (page 327).

Knowing the Government was really eager that the beauties of the country should be open to travelers, I ventured to suggest this reform, and Iranian correspondents have written me since that the situation is considerably altered and that such troubles now rarely hold up the visitor.

Photograph by Segruvian

HOMEMADE BREAD IS BAKED IN A HOT PIT

The housewife is about to slip the thin sheet of dough from the pad into the heating chamber. Embers at the bottom keep the walls so hot that two hundred "sheets" of bread may be baked at one firing.

OLD GIVING WAY TO NEW

Today in Iran there are hordes of bright little boys, rushing out of schools with businesslike attaché cases. They are dressed in European clothes and wear military caps. One little fellow asked a friend of mine the distance between New York and Boston. These youngsters are becoming the capable young citizens of the future.

Though the chuddar is no more, I regret the passing of some of the old sights, like the old men in their flowing robes and their henna-dyed beards entering the mosques to pray.

I hold for Iran the warmth in my heart that my father held for her. She has bewitched me with her enchantment, with the blue tiles of her mosques, the burnt sienna and rose madder of her endless plains, and the violet blue of her mountains tipped with snow. I want to see her make good in her new and great experiment as one of the noblest countries of the world from which we can all learn something.

Photograph by Joseph S. McCoy, Jr.

TALES AS TALL AS HER TOWERING MASTS ENSHROUD VENERABLE "AUSTRALIA"

A Civil War prize still in service, the schooner was captured by the United States brig *Perry* off the North Carolina coast in 1862, when she was under British registry as the *Alma,* and was running the blockade. Some Chesapeake Bay historians believe *Australia's* keel was laid in the 18th century, and that under another name she was captured by the Americans while participating with a British fleet in the bombardment of Fort McHenry in 1814. Once completely rebuilt, and often repaired, most of her original timbers are gone. Today *Australia* is owned by the Woodfield Fish and Oyster Company, of Galesville, Maryland, and placidly plies the Bay with cargoes of coal and oyster shells.

CHESAPEAKE ODYSSEY

An 18-foot Sailboat Follows the Course of Captain John Smith around This Spacious Bay of History, Commerce, Sea Food, and Nautical Lore

By John Maloney

CAPTAIN WILLIE NEWTON, craggy face tanned by strong sun and salty winds, leaned his adz against a pine log and gazed affectionately on a little boat sailing into the harbor.

"Aye, she's confident appearin'," he said as the trim craft luffed to her mooring, "and don't she, now, do all my braggin' for me?"

His words and manner reflected an artisan's delight in fine handiwork. And justly so, for the boat skimming in with the grace of an albatross was his creation, hewn from tree trunk into canoe forty years ago.

Cruising Chesapeake Bay, we had put into Messick, Virginia, for the night, our 18-foot sailboat spray-drenched by the long beat down from the Potomac's mouth.

As chips flashed fresh and white from pine logs he was shaping, Captain Willie told us the hardest thing about building log canoes was delivery to the purchaser.

"Aye, man, I love my boats," he sighed. "When I build a thing so beautiful I want to keep her myself."

Captain Willie was practicing an art older than white men's knowledge of the Western World. When Captain John Smith in 1608 was seeking a passage to Pacific and South Sea waters through a Chesapeake tributary he was amazed at Indian skill in building similar log canoes.

"With great lack of tooling help," he wrote, "they yet build exceeding well."

IN THE WAKE OF CAPTAIN JOHN SMITH

We were following Smith's tracks around America's "Mediterranean," poking up rivers and coves that were wedges of entry into the then unknown country. During winter evenings in Washington, D. C., we had traced the colonial captain's original courses as logged in his *True Relation* and *Generall Historie* (page 359). Log canoes were only one of many links we were to find connecting the early explorer's day with ours.

As owner and skipper of the mahogany-hulled sloop *Tralee,* I carried as additional crew Bob Miller, Washington high school lad, who was mate and second in command, and Malcomb Delbos, member of a foreign embassy staff, our navigator and cook.

Because of her 7-foot beam, 18-foot overall length, and big open cockpit, *Tralee* was sometimes called "the bathtub" by sportive friends. She was suited for this "voyage of rediscovery," because there were few shallow tributaries she could not explore. Her 26-foot mast carried 200 square feet of canvas, yet she drew only 18 inches with centerboard up, three feet with it down (page 360).

Ever since Captain John Smith's day the Chesapeake has been a concourse for coastal and sea traffic. Many clipper ships, at the height of their popularity and usefulness in the nineteenth century, took shape in Bay shipyards and sailed out over the Seven Seas, making records that still stand for vessels propelled by wind. And of the surrounding country, Smith wrote backers in England:

"Heaven and earth never agreed better to frame a place for man's habitation. . . . Here are mountains, hills, plains, valleys, rivers, and brooks all running most pleasantly into a fair Bay, compassed but for the mouth with fruitful and delightsome land."

Colonists who followed Smith depended upon the inexhaustible supplies of fish and shellfish before crops were cultivated or when they failed. Today fishing is still a major source of income for both Marylanders and Virginians, and the Bay's sandy beaches are centers of recreation for 20,000,000 persons living within easy driving distance of its shores (map, page 360).

One day's sailing southward from the Potomac brought us to Mobjack Bay, an 18th-century pirate's lair. Here we took on Stephen Decatur, great-grandson of the commodore and enthusiastic authority on America's naval past.

Next day we tacked into the York River's mouth. As we passed Gloucester Point, Decatur said, "Believe it or not, we are sailing over the hulks of British men-of-war,

Photograph by Paul Pryor

"MINE'S A DISAPPEARIN' TRADE," SAYS CAP'N WILLIE

He is one of the few builders of log canoes left in the Chesapeake region (pages 357 and 377). When large tree trunks were available he hewed hulls from two logs in his Messick, Virginia, shipyard. Generally, now, he uses three smaller logs—two for the sides, one for the bottom. Indians built fires in the logs and scooped the charred hearts to shape forerunners of these canoes.

sunk 158 years ago during the Siege of Yorktown (page 367).

"When Lord Cornwallis attempted to establish a southern naval base here," he explained, "his plans were short-lived. Ten British ships were bottled up in the river by De Grasse's fleet. American and French batteries on shore sank them."

BURNING YORKTOWN FRIGATES

Later we read an eye-witness account of this naval action by the American army surgeon James Thatcher. "A red-hot shell set fire to the *Charon,* a British 44-gun ship, and smaller vessels in the river, which were consumed in the night. From the bank of the river I had a fine view of this splendid conflagration. The ships were enwrapped in a torrent of fire, spreading with vivid brightness among the combustible rigging and running with amazing rapidity to the tops of the several masts, while all around was thunder and lightning from our numerous cannon and mortars."

For more than a century and a half these wrecks rested undisturbed in 60 feet of water. Research experts delving into Revolutionary history wondered if the wooden hulls could still be there.

In 1934-35, as a joint undertaking by the Colonial National Historical Park and the Mariners' Museum at Newport News (page 362), divers were lowered from barges. Groping through mud and oyster shells in the murky light, they encountered two wrecks, men-of-war beyond doubt.

Uncovering the hulks with high-pressure streams of water, the divers found many barnacle-encrusted relics: eight 12-pounder guns, pewter drinking mugs and candle sticks, long pieces of rope and hawsers with anchors still intact, and cans of bright-red paint used to camouflage the decks so that squeamish sailors would not become

OULD
VIR GI NI A
A description of part of the adventures of Cap. Smith in Virginea.
Graven and extracted out of ye generall history of Virginia, New England and Sommer Ilo. by Iohn Smith

EXCITING ADVENTURES OF CAPTAIN JOHN SMITH ARE PICTURED IN ENGRAVINGS FROM HIS "GENERALL HISTORIE OF VIRGINIA," FIRST PUBLISHED 1624

Depicted here are scenes of the doughty captain's fights with the Indians, in which he slew three warriors and was captured (left center); "Their triumph about him" (upper left); "Their conjuration (trial) about C. Smith" (upper center); "C. Smith taketh the King of Pamaunkee prisoner 1608" (upper right); "King Powhatan comands C. Smith to be slayne, his daughter Pokahontas beggs his life" (lower right); a map (center) of the regions about "Roanoak" Island and the "Ould Virginia" coast from Cape Henry (right) south to Cape Fear (left); and "C. Smith takes the King of Paspahegh prisoner."

faint-hearted when blood flowed. Hulls were too fragile to hoist, but, except for sails, nearly every item of a frigate's rigging was recovered (page 363).

The officers of those ships must have lived well. From the captain's quarters 200 wine bottles were brought up; but the divers were disappointed because the corks had rotted and let in Bay water! Cleaned of mud and barnacles, the bottles glowed with iridescence as a result of the long submergence. Mortars for grinding pills were discovered, possibly for the treatment of hangovers and seasickness!

Names of the ships remain a mystery, but logs and naval lists are being searched to find a record of a certain "Edward New." His name, the only clue to the vessels' identity, was scratched on one of the bottles.

We docked at Yorktown's ferry slip and saw the marker on the spot where Lord Cornwallis surrendered to General Washington, the king's men marching to the field with their regimental pipers playing "The World Turned Upside Down!"

Yorktown was a cargo-piled port in colonial times, but now it is only a village. Sight-seers stroll along streets once crowded with swaggering ship captains, colonial dandies, and planters bringing their tobacco and potatoes for shipment to Europe and the West Indies.

Yet sometimes still the steep bluffs under Yorktown echo the sharp staccato of ships' bells and orders bellowed from navigation bridges, for battle fleets have assembled on the York's wide estuary during every American war since the Revolution.

We sailed away from Yorktown with a promising dawn, but as we rounded Old

Photograph by Willard R. Culver

"TRALEE" PAYS A CALL AT SMITH ISLAND

Oil stove on dock, Chips sets the coffee boiling while Skipper lowers the sails. Although only 18 feet in length, *Tralee's* 7-foot beam allowed "stretching" room for four sleepers. A canvas cover across the boom sheltered the crew in rainy weather.

Point Comfort and ran before the wind into Hampton Roads the sun disappeared behind dark clouds. A menacing sea became purple, and whitecaps shattered into bullets of spray as the wind blew up for our first taste of ugly weather.

Tralee heeled, staggered up, and heeled again. As we sighted Fort Monroe's walls dimly through the mist, a real southeaster struck and we lowered sails just in time to prevent a spill.

BIRTHPLACE OF AMERICAN MEN-OF-WAR

Singing "Blow the Man Down," we worked our way, under reaching jib only, into the Hampton Yacht Club's cosy anchorage. There members helped us spread sails to dry in their loft, and drove us to a dinner of sizzling grilled salt-water eels and—what a combination!—Chinese chow mein, in Newport News.

From the ways at the Newport News Shipbuilding and Dry Dock Company have gone merchantmen and American naval vessels to carry commerce and prestige into every port from Penang to Spitsbergen (page 370).

"Our affection for ships we've built follows them through far seas like that for absent sons and daughters," Homer L. Ferguson, president of the company, told us. "And they turn homeward when they're in trouble, to have their engines repaired, their hulls repainted, and the barnacles scraped from their bottoms."

While we stood looking over the yard from the steel flight deck of the aircraft carrier *Yorktown,* then building, word came that the *President Hoover,* luxurious Pacific liner off these ways, had been bombed by airplanes on the Yangtze below Shanghai.

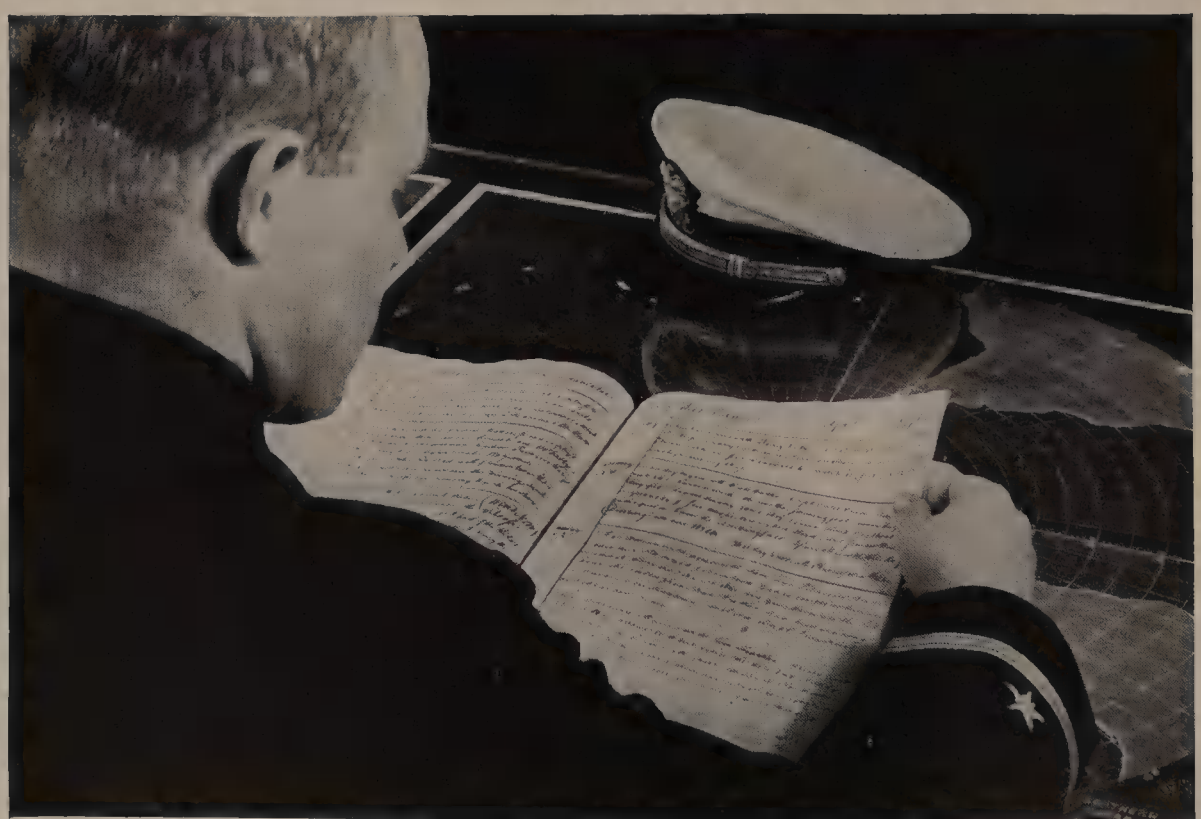
Drawn by Newman Bumstead and Ralph E. McAleer

IN CAPTAIN JOHN SMITH'S TRACKS, "TRALEE" CRUISED CHESAPEAKE BAY

Following the shoreline and poking up tributaries of "America's Inland Sea," the little sloop's skipper and crew spent 28 days on their voyage. They touched at many places first visited by the Bay's earliest explorer.

NEW ENGLAND WHALERS CARVED SCRIMSHAW FROM WHALEBONE AND WALRUS IVORY

The collection in the Mariners' Museum at Newport News is one of the largest in the country. A harpooner's yarn is illustrated on whalebone (upper left). Spurlike designs were for crinkling pie crusts; the carving with four designs (center) is a "buskin," or corset stay. At right, a knife sheath.



Photographs by Paul Pryor

A YOUNG ENSIGN STUDIES NAVAL HISTORY AT FIRST HAND

The log of John Paul Jones' "Continental Ship of War," *Ranger*, is a guarded treasure in the Mariners' Museum. The entry for Tuesday, April 27, 1779, reads, "This day begins with rainy weather"—but the crew cleaned ship, nevertheless. One year later *Ranger* was captured by the British at the fall of Charleston, South Carolina, and added to the Royal Navy under the name *Halifax*.

Photograph by Paul Pryor

WATER COVERED THESE RELICS OF BYGONE FRIGATES FOR 153 YEARS

Recently, divers located hulks of British men-of-war sunk off Yorktown in 1781. In the Mariners' Museum at Newport News are displayed cannon, wine bottles, table silver, cans of red paint, and many objects recovered from the muddy bottom of the York River (page 358). The rigging blocks of lignum vitae (center and lower right) still revolve freely, and the anchor hawser (on wall in background) could hold a fair-sized ship.

"When Simon Lake in 1898 took the first successful submarine, the *Argonaut First,* out through Hampton Roads for trial runs in the Chesapeake," Mr. Ferguson said, "Jules Verne prophesied that submarines and navies of the air would be factors in the next war!"

In the mold loft, where parachute spinnakers for fifteen America's Cup defenders could be laid out without touching, we saw a heavy cruiser flat on the floor! Actual-sized templates of a 10,000-ton vessel were being fitted by sections before corresponding parts were fashioned in steel.

Residents of this James River section are particularly "ship minded." A young real estate dealer sailed with us across to Norfolk to explain new housing developments for workmen. In his office we examined handmade clipper models and forgot slum-clearance projects!

NAVAL HISTORY MADE HERE

"Norfolkians insist the War of 1812 was brewed in our harbor," he said. "On June 22, 1807, British officers of H. M. S. *Leopard* boarded the U.S.S. *Chesapeake* shortly after she had sailed for the Mediterranean, and demanded the right to search the ship for deserters. Commodore James Barron refused. Thereupon the British vessel opened fire with broadsides on the unprepared *Chesapeake* and forced her to surrender. Although five years elapsed before hostilities began, the 'Chesapeake Affair' was a major cause of the war."

David Farragut in 1826 gathered youngsters from warships anchored here in Hampton Roads and established America's first naval school, a floating "Annapolis" aboard the U.S.S. *Alert*. Ninety-three years later almost 300,000 young Americans sailed past *Alert's* old anchorage to fight in France.

In a bullet-shaped amphibian plane from Hampton Roads Naval Air Station we looked down on factories for assembling automobiles, weaving silk, freezing fish, packing oysters, cleaning peanuts, rolling steel doors, processing soy beans, canning and pickling fruits, stemming tobacco, knitting underwear, roasting coffee, and making paints, veneers, and cement.

"Upriver at Jamestown America's foreign commerce was born," our pilot said, "and here below us it was cradled." Flying at 2,500 feet, we could see eight trunk railways spreading fanwise into the interior.

WHERE "MONITOR" FOUGHT "MERRIMACK"

Inside Fort Monroe we chatted with artillerymen living in quarters where Jefferson Davis was kept a Government prisoner for two dreary years. Under massive walls of stone and earth an enlisted man showed us the bedroom of the former President of the Confederacy.

From atop the walls President Lincoln watched Federal ships shell Confederate privateers across the Roads at Norfolk. And from the fort we could see where was fought the battle between those forerunners of modern ironclads, the *Monitor* and the *Merrimack*.

As we examined scale models of these strange-looking sea-fighters in the Mariners' Museum, we could imagine the excitement caused in the fishing fleets when they were first sighted. To Chesapeake sailors the ironclad was "a sea serpent thrashing along, smoke spouting from its gills"!

INTO THE CHESAPEAKE'S MOUTH

From Norfolk's inner boat basin we sailed again on a dull, fog-obscured morning. Army bombing planes from near-by Langley Field roared over our heads as *Tralee,* matching speed with two local yachts, reached down Hampton Roads. In protected waters they showed us their heels, but once we struck open stretches *Tralee* plowed ahead while her crew dipped the burgee in farewell.

Holding past Lynnhaven Roads, we plotted our course to carry us across the Bay's mouth from Cape Henry to Cape Charles, New World "Pillars of Hercules."

Fog, thickening, obscured all before us as we sailed across the merging waters of the Chesapeake and the Atlantic.

Mate Bob suddenly shouted, "Must be a storm brewing! I hear thunder!" But it was only the big coast artillery gun of Fort Storey, firing at targets 17 miles at sea.

A CLOSE SHAVE IN THE FOG

The Chesapeake of John Smith's time was untraveled water, except for casual Indian canoes. But crossing the steamer lanes between the Capes today in a fog is a different matter.

Sandwiches were being distributed when Mate Bob, dozing at the tiller, sat up suddenly.

"I hear foghorns!" he warned. Almost simultaneously two deep blasts shattered the gloom, one to starboard only a cable's length away. Seconds passed slowly as we tooted our horn. Soon we heard the noise of propellers churning water, and the swish of bow waves. Cook jumped up on *Tralee's* foredeck.

"She's on us!" he yelled, and dropped our one foghorn overboard in his rush to rip zippered jacket off.

Could we clear? There were clangings of engine-room bells aboard the mountainous hulk bearing down on us, more threshing of propellers. *Tralee* bobbed like an empty bottle as the steamer slid past, thirty feet to spare. On her stern were Japanese characters and the name *Fusan Maru.*

As the freshening southwest breeze lifted the fog, we picked up faintly the lights of Cape Charles Harbor. The mate, enjoying the fair breeze with lee decks awash, called out, "If we had a *real* cook-navigator now, we'd have dinner on deck and keep running up the Bay, wouldn't we, Skipper?"

It worked! While cook set up his two-burner gasoline stove, *Tralee's* bow was turned due north with Polaris as a steering mark.

Two miles to starboard lay the Virginia peninsula's low-lying coastline, dimly bathed in moonlight. On beaches here, Indians introduced settlers to the delights of Chesapeake terrapin, clams, and oysters. At midnight, with Vega showing bright through our port shrouds, we passed Cherrystone Island, Virginia's famous "clam ground."

Fifty miles above Cape Charles the peninsula narrows until in places only eight miles separate Atlantic swells from the comparative quiet of the Bay. From many little harbors alongshore, schooners, "bugeyes," "pungies," and other small craft loaded with melons, strawberries, and potatoes, sail across to city markets.

The moon sank early in the morning hours, and in the darkness *Tralee's* wake was clearly outlined by a phosphorescent trail astern. The mate and cook stood turns with me at the tiller, the two off duty stretched out on floorboards for cat naps.

Awaiting a breeze at seven o'clock, we scrubbed decks between dives overboard

Photograph by Paul Pryor

WOULD YOU LIKE A MICKEY MOUSE OR A MERMAID?

Much patronized by merchant marine seamen and Navy sailors is this tattoo artist at Norfolk. He offered *Tralee's* crew 1,500 designs to choose from. None was quite suitable, however! Artists use electric needles and fast-color dyes.

while Cook Delbos prepared pancakes with honey. Mate Bob was under *Tralee's* teak bottom detaching seaweed from the centerboard and rudder when skipper, standing on the bow, shouted:

"There's some big monster swimming toward us!"

Mate's hop aboard was amazingly fast! As the creature swam closer, we saw that it was a loggerhead turtle, ragged patches of moss growing on its three-foot-wide back. Head drawn under its shell, it waved huge flippers to propel itself through the swell.

Quickly we fashioned a noose and attempted to lasso the turtle, but it disappeared with a piglike grunt when the rope touched its hard covering, shattering dreams of soup and stew.

We passed Pocomoke Sound and, just south of Tangier Island, ran close to the derelict U.S.S. *Texas,* her steel decks awash at low tide. Well-placed Navy bombs sent her to rest here in 1919, a life of usefulness as a guardian of our coasts ended. Fish swam through rents and portholes in her sides—shadowy occupants of wardrooms and captain's quarters where war games once were planned.

At Tangier's channel buoy a crabbing boat threw us a line for a tow. On the dock inside we found my young brother, up from inland Tennessee for his first taste of sailing and salt water. Christened "Chips," he was put to work repairing sails and rigging.

PRESIDENT WILSON'S PARTY WAS MISTAKEN FOR ENEMY RAIDERS ON TANGIER

Tangier village reminded me of bits of rural Ireland I had tramped through years before. Its two narrow, crooked streets of spick-and-span houses, with zinnias and bachelor's buttons growing along the walks and honeysuckle climbing the fences, seemed Old World in atmosphere (p. 378). Women in gingham bonnets gave shy greeting as they passed. Older men, some looking as though they might be kin to time itself, smoked clay pipes in sunny corners.

Photograph by Willard R. Culver

HERE, ON CAPE HENRY, CAPTAIN JOHN SMITH AND HIS COLONISTS FIRST LANDED IN AMERICA

Ships under the command of Captain (later Admiral) Christopher Newport sought shelter in the Chesapeake on April 26, 1607. This forced landing led to the founding of Jamestown, on the James River, the first permanent English settlement. After planting a wooden cross where the stone shaft now stands, John Smith wrote to his backers in England: "The show of land there is white hilly sand . . . and along the shores great plenty of pines and firs."

Photograph by Willard R. Culver

COLORS STILL FLYING, THE GRAND FRENCH BATTERY AT YORKTOWN LOOKS TODAY AS IT DID IN 1781

As a unit in the first parallel that encircled the British army, it helped silence enemy artillery and force the surrender of Lord Cornwallis. The gun in the foreground is a French stone mortar used during the siege. The three cannon in the background are American cast-iron guns of 1797. The red, white, and blue flag at the left was flown by the Gatinois Regiment, which served with gallantry and distinction at Yorktown. The French Royal flag, on the traverse (right), was flown by the French troops in America. The United States National Park Service restored the battery in 1935.

Photograph by Melville Bell Grosvenor

WHITE SAILS FLUTTERING LIKE BUTTERFLIES' WINGS, STARS AT GIBSON ISLAND LINE UP FOR A LABOR DAY REGATTA

Photograph by H. Robins Hollyday

HOW RACES ARE WON! YACHTS AT TOP HAVE CAUGHT A FAINT LAND BREEZE, PASSING THE BECALMED ONES (FOREGROUND)

Chesapeake winds sometimes are light and tricky in summer months. Alert skippers take advantage of wind shifts to bring their boats home first, as is illustrated in this race of the Chesapeake Bay Yacht Club. Freshening puffs, indicated by ruffled waters along the shore, have billowed out the spinnakers and mainsails of some of the yachts, while the sails of the others hang empty. In the background lies pleasant Eastern Shore farmland, deeply indented with rivers and inlets.

CRASH! "I CHRISTEN THEE 'ENTERPRISE'"

In October, 1936, this new aircraft carrier slid down the ways of the Newport News Shipbuilding and Dry Dock Company, and in May, 1938, she was commissioned by the United States Navy. Now she is a part of the fleet and is home to 2,072 officers, sailors, and aviators, and 90 bombers, pursuit ships, and observation planes which land and take off on her big flight deck. This is the prow of the *Enterprise*, not her stern. The bulbous bow decreases "skin resistance" and shapes the flow of water along the hull, giving her a maximum speed of approximately 32.5 knots (page 360).

During World War days President Woodrow Wilson, week-ending aboard the Presidential yacht *Mayflower,* led a party ashore here for a stroll and was amazed to see windows of homes closed and barred. An old man finally ventured out to explain the "deserted village." Natives, glimpsing gold braid and military uniforms, had fled, thinking the group was the crew of a raiding German submarine!

Vocations on Tangier are limited. Of the island's 1,300 residents, all men are fishermen except eight storekeepers, the doctor, minister, and four schoolteachers. "And even we like to handle a hook and line occasionally," the minister said.

"We have our problems, though," a storekeeper explained. "Accustomed to isolation and few contacts with mainland folk, we're undecided whether to welcome visitors for their money or preserve our simple life."

"Which school of thought is winning?" I asked.

"Greed is in us, too," he answered.

But we found no greed on Tangier. Housewives offered us cabbages and jars of home-grown figs; fishermen gave us crabs and fish.

Into every conversation crept yarns about the famous "Parson of the Islands," Joshua Thomas, who traveled between the settlements on Tangier, Smith, and Deal Islands in the log canoe *Methodist,* exhorting sinners, marrying the young, and burying the dead.

While the British were preparing to assault Baltimore in 1814, their ships anchored off Tangier and quartered their men ashore. Parson Thomas endeavored to convince them of impending failure.

" 'Ye'll never take the place,' " an old fisherman quoted Thomas as saying, "and sure enough, they didn't. But before they moved on to storm Fort McHenry at Baltimore the poor critters begged parson to pray for them—and he did, for those that deserved it!

" 'But those we kill,' the parson warned in his prayer, 'may God protect their starvin' families back in the auld country!' "

"THE ADMIRAL" COMES ABOARD

We were hoisting sail at daybreak for a run across Tangier Sound to Crisfield, Maryland, when a barefoot ten-year-old peered down from the dock above us.

"Maw said if'n you'd take 'im then paw couldn't drown 'im," he mumbled, dropping an animated sack into the boat. Inside we found a badly frightened kitten, half-grown, with snow-white markings on coal-black coat. When we looked up the donor had fled.

The uninvited guest promptly crawled into the bow and made a place for himself atop our baggage. He became "The Admiral."

Heading *Tralee* toward the mainland, we slipped through lines of gasoline fishing boats and sailing vessels going to market with rich hauls of fish or decks loaded with farm products. Unpleasant odors of others passing to windward indicated fish refuse destined as fertilizer for growers up the Bay's many tributaries.

In Crisfield we visited a terrapin farm to see diamondbacks being raised for city customers willing to pay $25 to $35 a dozen for them (page 372).

By pre-arrangement National Geographic photographer Willard R. Culver joined us here for a trip to Smith Island, nine miles offshore.

We headed into rough water outside Crisfield's harbor. Spray flew half mast-high. Oilskins were commandeered from the crew to protect camera cases from seas that splashed into *Tralee's* cockpit.

"Do you think she can take it?" we heard Culver ask Chips, and were too busy with tiller and mainsheet to laugh when Chips answered, rather doubtfully, "I . . don't . . know." But we *did* make it.

A circuitous channel led into Ewell, largest of Smith Island's three villages. Because our arrival had been expected for days, "Mother" Whitelock, wife of the mailboat concessionaire, had come to the docks when our white sails were sighted, wind-and-wing.

On the landing crowded with men, women, and children eager to see our "funnin' (pleasure) yatcht" the gracious lady who was our sponsor on the island seemed dumbfounded:

"Merciful heavens!" she gasped as we climbed ashore. "You didn't come from Washington in that mite of an open boat?"

"Come ashore," she said when canvas had been furled and decks tidied, "and I'll see if I can roust up a bite." As recorded in *Tralee's* truthful log, the "bite" included these:

Oysters on the half shell, oysters scal-

Photograph by Jacob Gayer

WHICH SHALL IT BE?

Into the tub and on to the market, or back into the pound? The immediate future of these diamondback terrapins at Crisfield, Maryland, depends upon their width across the back. If large enough, they command fancy prices (page 371).

loped, oysters fried—three to a golden-brown cake and direct from our host's oyster beds—crabmeat salad, green beans and slaw, stewed apples and fig preserves, and porkchops we couldn't touch for lack of space!

Smith islanders live to themselves. Until Captain Whitelock "imported" a small truck to haul heavy freight to the other two island villages, some had never seen an automobile. We met old people who had ventured only to Crisfield on the mainland, then hurried home to escape noise and confusion that frightened them.

RED CROSS SUCCORS ICEBOUND ISLANDERS

When Chesapeake Bay froze almost solidly in January, 1936, and boats could not cross Tangier Sound, rumors spread that Smith and Tangier residents were starving. Red Cross food was dispatched from Washington and Crisfield to be dropped by parachutes, and islanders had their first close-up view of airplanes.

Community life centers around three Methodist churches in the villages, and "camp meetin' time" climaxes their year. Captain Whitelock's mailboat is their sole connection with the mainland. A Red Cross nurse watches the health of 900 residents during harsh winter months.

"Come to our square dance tonight," the village schoolmistress said when she came down to inspect *Tralee*. That evening, in a warehouse, 50 young men and women danced to music from a nickel-in-the-slot phonograph, drank soda pop, and laughed at our crude attempts to imitate their staid and stately steps.

Fuel must be imported from the mainland, so we were surprised to see fishing boats rotting along tidal creeks. I asked a 15-year-old who volunteered as camera carrier why one ship skeleton we came across was not burned long ago (page 374).

"Belongs to Bill Evans," he answered.

"Wouldn't he let you burn it?"

"Don't think so; he's been dead ten years."

"SNAKE HAWKS" ARE SMITH ISLAND WEATHER PROPHETS

To Captain Whitelock we commented on the excellent weather and favorable winds we had had since casting off from Point Lookout eight days earlier.

Photograph by A. Aubrey Bodine

AWAITING A CHANGE OF RAIMENT

Crabs are left in shallow floating boxes until they shed their hard covering. Before the new armor hardens, the "soft-shells" are removed from the water and shipped to market, carefully packed in seaweed. Because of their many changes of shell before reaching maturity, crabs are frequently called "Beau Brummells of the sea."

"You've got to pay back all this southeast weather, lads, and don't forget it," he prophesied, pointing to dragonflies hovering close over the water. "When them 'snake hawks' fly low, watch out for a change!"

Docks were crowded with our new friends when we hoisted sails early next morning. Even Admiral, now thoroughly at home aboard *Tralee,* arched his back and purred a farewell as we slowly worked down the channel to open water.

Outside in the open Bay crisp morning air and a cloudless sky promised a smooth run northward to the Choptank. Off Holland Island Bar Lighthouse a school of "puffin' pig" dolphin, graceful deep-sea mammals seldom seen in the Chesapeake, passed close to us in swift pursuit of mackerel. Leaping from wave to wave, they rapidly left us astern.

In the lee of James Island, at the Little Choptank's estuary, we anchored among a fleet of bugeyes and pungies awaiting ebb tide (page 380). "Come aboard and eat with us," the Captain of the *Jennie V* of Cambridge called, and to the cook's delight we accepted.

Enjoying fried sea trout and corn-on-the-cob, we admired the spick-and-span decks and fishing equipment.

"She must be a new boat," Chips said.

The owner-skipper laughed. "During the Spanish-American War my father used her to carry Eastern Shore foodstuffs to battleships in the Patuxent River, and she was old then!"

YARN OF THE PIRATE BUGEYE, "MARY PARTRIDGE"

"Bugeyes make spankin' good pirate ships," the *Jennie V's* skipper told us. "Did'je ever hear tell of the *Mary Partridge* and old Cap'n Kim Caleb?" When we shook our heads, he leaned back against the railing and filled an evil-smelling pipe with home-grown leaf:

"Cap'n Kim come to the Bay country from nobody knows where. 'Put me up a bugeye 80 foot long and double quick,' he says to a boatbuilder at Solomons Island, and throws a fistful of gold pieces on the ground to show he meant business.

"Well, sir, that there bugeye warn't built more'n a month afore Cap'n Kim

Photograph by Willard R. Culver

A MEMORIAL TO A DEPARTED FISHERMAN IS THIS DESERTED HULK

Wood fuel must be brought from the mainland to Smith Island. Yet rotting boats whose owners have died ashore or been lost at sea are held inviolate monuments to the men who skippered them through calms and storms.

showed his rightful colors. He wuz a pirate! An' off Rappahannock Spit down Virginia way he took his first boat, a leaky Bay schooner fightin' head winds and beatin' into Norfolk.

"Revenue cutters laid for 'im up creeks and behind fishin' fleets, but Cap'n Kim could always smell 'em," the skipper went on. "Every time they chased 'im he'd show 'em his heels, and he wouldn't stop fer rough water at the Capes, neither.

"But 'e wuz got," the skipper chuckled. "Grandpap and the oystermen finally got 'im!

"He come up on a dredgin' fleet one day by Sharps Island, and when he luffed up he hollered fer 'em to throw 'im their money and five bushels of oysters. Grandpap talked low to them around 'im, and afore Cap'n Kim knowed it all the boats wuz headin' in to the *Mary Partridge*, and they smacked her bows first. All the oystermen had their muzzle-loaders out when they hit. My own grandpap shot 'im!"

"And got the reward for his 'carcass'?" I asked.

"Shucks, no," he said. "When he wrote Washington they told him there wuz a war bein' fit between the States, and that Jeff Davis wuz the Secretary of War that promised the reward, so his promises warn't worth their weight in dry seaweed!"

At 5 o'clock the tide was flood, and with a pleasant sound of creaking gear the fishing fleet hoisted sails and stood out from shore closely bunched, tacking southward toward the Capes.

Around Cook Point in the Choptank we found a snug-appearing little inlet and anchored for the night. We were inflating

Photograph by Paul Pryor

FISH TRAPS ARE THE BANE OF SAILORMEN ON THE BAY

Shaped like giant spears, long nets on poles fringe both shores to snare migrating fish. In the haul from this pound net near Dares Beach, Maryland, the fishermen took hardheads or "croakers," herring (alewives), shad, Norfolk spots, and perch.

rubber mattresses, used as makeshift bunks on the floorboards, when Chips glanced up at the burgee at the masthead, and remarked, "Maybe Captain Whitelock and his 'mosquito hawks' were right. Wind is shifting and those black clouds are moving toward us from the nor'east."

Admiral climbed on deck, peeped overboard at the waves beginning to slap alongside, then huddled back against the mast, mewing and glancing shoreward.

Mate Bob and I stood watch as the night grew blacker. *Tralee's* steel backstays whined as the wind tore past. The boat pitched and rolled like a young colt straining at the halter. Hail bombarded the deck and the tarpaulin across the boom that formed our "cabin."

Our 40-pound anchor began to drag. Anxious moments followed while we worked *Tralee* farther from shore and dropped a spare 20-pounder. For three hours we tossed until a steady rain began, bringing calm.

At dawn cook went ashore and over a driftwood fire prepared a breakfast of grilled sea trout and fried corncakes *à la Maryland*. Before the sun was up we were off again.

Arriving at Oxford, we found a forest of tall masts and white sails. Six-, eight-, and ten-meter class yachts, sleek white cutters and schooners designed for ocean racing, log canoes, bugeyes, swift little skipjacks with raked masts, power cruisers, and star and comet sailboats lay off the flag-bedecked water front.

For two days starting guns boomed over the Choptank as races were run in heavy winds and light (pages 368-9, 377, 381).

During an evening aboard a sleek, white-hulled eight-meter (49-foot racing sloop), we heard amusing yarns of races and storms. Our hosts laughed when they recalled how the Chesapeake's freakish tides had tricked them into losing an overnight race.

TOWED BY AN ANCHOR!

"As night approached off Annapolis, the nearest rival yacht was some distance astern," the skipper said. "After dark the wind calmed and our sails flapped emptily. Suddenly, however, we saw the approaching red and green lights of our competitor, whom we thought becalmed far behind. Steadily she came, passing us on our port side. We could even hear her skipper whispering, 'Steady boys! Keep her as she is. Don't touch those sails.'

"Frantically we tried everything to make our boat go, but the other pulled ahead. Finally, in desperation, we let the anchor go. The instant it took hold our bows began to cut the water, and realization dawned. We had been drifting backward on the flood tide, while the other boat was at anchor."

While we made sail on our last morning in Oxford an old fisherman admitted that "city sailors" were puzzles to him:

"Beats me why all you grownups git out in them little boats and gad up and down this tricky Bay," he said. "I tell my old woman sich folks must have minners (minnows) in their haids!"

The god of winds was with us on the run around Tilghman Island, up Eastern Bay and the Miles River to St. Michaels, the sleepy little port where racing got its real start on the Bay before 1840.

SOME RACES COMIC, OTHERS TRAGIC

Comedy was mingled with the racing in those days. Log canoes were dragged on shore with sails furled. At a signal crews hauled the boats into the water, fixed rudders and made sail, many times tangling their gear and upsetting their craft.

Racing craft in the good old days were not pampered, fancily rigged boats, but oyster or fishing canoes used for practical purposes on all but gala days. Cash prizes were awarded and losers were presented with hams—"to grease their bottoms."

"During the War between the States races 'to the death' took place," a member of the Miles River Yacht Club at St. Michaels told us. "Southern sympathizers in canoes raced Yankee guard boats to run the blockade."

Natives of St. Michaels like to tell how their great-grandfathers tricked British warships bombarding the little port in 1813. Realizing enemy intentions in advance, residents carried lamps and lanterns to their rooftops. Guns trained at the "lighted windows" overshot the village and cannonballs fell harmlessly in fields hundreds of yards from the water front.

After a night at St. Michaels we sailed across Eastern Bay, and went ashore on Kent Island to look for traces of William Claiborne and the first trading post established for traffic with Indians on the Chesapeake.

Off this island one of the first naval engagements in North American waters took place, when Claiborne, who established his "factory" there in 1631, resisted efforts of Lord Calvert's colonists to claim the territory for Maryland.

Here, too, on an inlet opening onto Eastern Bay, one of America's earliest seagoing vessels was constructed. Claiborne and his "Kentish men" brought the materials, including tar, iron, pumice, square nails, and ship timbers up the Bay in canoes from "Kecoughtan," as Hampton, Virginia, was known to Indians and early settlers.

Claiborne dreamed of building a great shipyard here, and brought indentured shipwrights from Jamaica and the Thames to shape the hulls. But his dreams, like so many others conceived in that early New World, were shattered abruptly. Lord Baltimore and Maryland won the fight with Virginia for Kent Island, and Claiborne returned to London to seek redress he never found.

A descendant of early Kent settlers walked with us along the island shore pointing to supposed sites of Claiborne's blockhouses and depots for storage of furs and corn he later shipped to England. On the island, too, he showed us an old brick building which traditionally was the manor house of Claiborne.

"Before the Civil War a dozen plantations supported wealthy families here," my friend said. "But riches are like insects; when their wings grow out they fly away, and today Kent farmers are not so prosperous."

LEGEND OF BLOODY POINT

I asked him how Bloody Point, the southwestern promontory of the island and familiar to all Bay sailors, received its name.

Photograph by H. Robins Hollyday

"LAY OUT ON THOSE BOARDS, FELLOWS, BEFORE THIS GUST TURNS US OVER!" SHOUTS "JAY DEE'S" SKIPPER

Graceful log canoes, patterned after the original Indian models, still race on the Eastern Shore at St. Michaels and Oxford. They carry a tremendous press of sail for such a narrow hull, and are manned by large crews who lie out on the balancing outriggers. When the wind lightens between puffs, they must quickly crawl back into the boat or risk a ducking! As the craft tacks, the boards are transferred to the opposite side. An early explorer wrote: "The Indians call this Watry Waggon Canoo, a Vessel none can brag on; Cut from a Popular tree or Pine, and fashion'd like a Trough for Swine."

Photograph by Willard R. Culver

THERE'S NO TRAFFIC PROBLEM ON TANGIER ISLAND

The village's one narrow lane leaves no room for automobiles or horses, but it suffices for the closely knit fisherfolk who dwell on the isolated island in the Chesapeake. When President Woodrow Wilson, unannounced, walked ashore accompanied by naval aides in uniform during the World War, villagers hid behind barred doors, thinking an enemy submarine crew was invading their normal quiet (page 371).

"According to an old legend," he said, "an outlaw was hanged there and left swinging for days. Vultures eventually tore his body from the ropes. People around here say that on stormy nights the poor man still moans so that he can be heard above the noise of the wind."

Off Queenstown on the Chester River, where we anchored for the night, the sharp crack of rifles and small cannon split the stillness on a December night in '88. The Maryland police steamer *Governor McLane* attacked nine bugeyes banded together for mutual protection against the "law," scattering and sinking most of the fleet. Although many shots were exchanged, no lives were lost, and this was the last major battle in a century-long series of oyster wars.

From Queenstown we laid our course to the Bay's head. An overnight stop at Betterton, where yachting friends filled us with Maryland fried chicken, was our only pause before reaching Cabin John Creek on the Elk River. There in a quiet haven we let go the anchor, after a day of cross-chops and adverse winds.

"Would you like to tow upriver?" the skipper of an 80-foot cruiser from New York called. We took his line gratefully, and two hours later turned into Back Creek to sight the tall drawbridge across the Chesapeake and Delaware Canal at Chesapeake City.

With an Army engineer along to see that we "got into no mischief," we remained on the bridge when it was raised 140 feet to allow a Norwegian tramp steamer to pass into the Chesapeake.

CANAL HELPS SAVE THE UNION

"George Washington and Benjamin Franklin advocated the canal's construction," the engineer said, "but little was done about it."

Photograph by Willard R. Culver

A SHORT CUT FROM BALTIMORE TO PHILADELPHIA AND EUROPE

The 14-mile Chesapeake and Delaware Canal, first opened in 1829 but recently deepened, cuts across the peninsula between the Chesapeake and Delaware Bays so that Baltimore sea traffic need no longer round the Virginia Capes (map, page 361). When the center span of this bridge at Chesapeake City, Maryland, was lifted to the top of the towers, *Tralee's* crew watched ocean-going vessels pass under. In the distance gigantic dredges complete the digging.

"When the Capitol and White House were burned and Washington sacked by British General Robert Ross and Rear Admiral Sir George Cockburn in 1814, Congress saw the need for quick transportation of troops, and belatedly appropriated $450,000 to assist Maryland, Delaware, and Pennsylvania in digging the huge 'barge ditch.'

"The expenditure was justified," he continued. "At the beginning of the War between the States the canal helped save the Federal Government!

"On April 17, 1861, Virginia seceded from the Union and moved troops toward the National Capital where only a handful of men were guarding the city. Since every railway bridge from Baltimore to Havre de Grace had been burned, Union men could not be rushed to Washington overland.

"In Philadelphia every shallow-draft steamer was seized by Federal officers. Troops were loaded quickly, rushed down Delaware River and through the canal to Annapolis. They arrived in Washington when Confederate troops were storming the bridges across the Potomac. Lincoln himself said the canal was the Union's salvation."

Improvements completed early in 1938 moved Baltimore and Chesapeake ports 330 miles nearer Philadelphia by enlarging the channel to carry ocean-going vessels.

Rain poured next morning, but we put on oilskins and ran before the wind to Turkey Point at the mouth of the Elk River. There we anchored in a sheltered cove and climbed steep cliffs to visit America's only woman lighthouse keeper (386).

From Turkey Point we turned northwestward to Havre de Grace at the Susquehanna's mouth.

"For 46 years Captain Harry Moore has been a hunting guide on the Susquehanna's

Photograph by H. Robins Hollyday

THE ERA OF SAIL HAS NOT PASSED ON THE CHESAPEAKE—OYSTER DREDGERS MAY NOT USE POWER

Maryland and Virginia conservation laws prohibit the use of powered craft when dredging from public oyster beds. As a result, commercial sailing vessels are still common sights on these waters and such distinctive craft of the region as the Bay schooner (two left center), the bugeye, with two raked masts (upper center), and the skipjack, with single raked mast (foreground), have been preserved. These vessels are sailing slowly back and forth across the beds off Poplar Island, dragging big wire-mesh scoops over the bottom to scrape up the oysters. It was such a fleet of oystermen that put a finish to the pirate Cap'n Kim Caleb (page 373).

Photograph by Robert F. Kniesche

A JAM AT THE WEATHER MARK—JUNIOR SKIPPERS RACE IN "L. J." BOATS AT GIBSON ISLAND

To qualify for the Junior Fleet, the five-to-fourteen-year-old youngsters must be able to swim fifty yards. They take their racing very seriously. Parents watch the races from large yachts anchored in the harbor and listen to the "seagoing" language passed back and forth between the youthful captains. The 11-foot boats, designed by Lowndes Johnson, cannot sink. Skippers are trained to cling to their little ships until rescued should they turn over in the sudden squalls that occur on the Chesapeake.

Photograph by A. Aubrey Bodine

"HELLZ A POPPIN'" OVER THE BETHLEHEM STEEL PLANT AT SPARROWS POINT

Into this blast furnace on the Patapsco River below Baltimore is poured iron ore, coke, and flux (a mixture of limestone and dolomite). Resultant steel may go into nails, refrigerators, automobiles, or streamlined trains. Steel for San Francisco's Golden Gate Bridge was rolled here. By-products of the furnace include cooking gas, coal tar, cement, fertilizer, and road-building materials. Nightly glow of hot slag from the furnaces points the way to Baltimore for sailors far out on the Bay.

Photograph by Robert F. Kniesche

FORT MC HENRY SPLITS ASUNDER BALTIMORE'S THREE-PRONGED HARBOR AND COMMANDS ALL ENTRANCES

The flag that inspired Francis Scott Key waved "o'er the land of the free and the home of the brave" from a staff where the present one stands inside the ramparts. Clipper ships from many seas docked along "Canton row" on the opposite side of Northwest Harbor (upper right), which comes to a dead end in the business heart of the city. Chesapeake Bay is ten miles down the Patapsco River from the fort (pages 386 and 392).

Photograph by Robert F. Kniesche

FUTURE ADMIRALS ARE TRAINED AT ANNAPOLIS, WHERE COLONIAL FORT SEVERN ONCE STOOD

When the United States Naval Academy was founded in 1845, fort buildings were used as classrooms. Today Bancroft Hall, one of the world's largest dormitories, covers its site at the mouth of the Severn River. The sharp spire (lower center) is Maryland's State Capitol, surrounded by a city proudly preserving many fine colonial homes (page 391). Across the river is Greenbury Point and the Naval Radio Station. On the Chesapeake's far shore (upper right) lies Kent Island, seat of Claiborne's colonial trading post (page 376).

Photograph by A. Aubrey Bodine

FROM FEDERAL HILL PARK LOOMS SKYSCRAPER ROW ACROSS BALTIMORE'S "MAIN STREET" DOCKS

Up this canyonlike finger of the city's spacious harbor (page 383), come bananas from South America, melons from Maryland "landings," and oysters and crabs from the State's vast "sea-food pasture," Chesapeake Bay. Docking in the business section, steamers carry passengers to isolated Bay places where they also unload yokes for ox teams, supplies for tobacco farms, millions of cans for Eastern Shore tomato growers. Once a signal tower on Federal Hill flashed merchants the news of incoming clippers bearing silk from China, coffee from Brazil, and spices from the Indies.

Photograph by Willard R. Culver

SAILORS' LIVES ARE IN HER HANDS

Mrs. Fannie M. Salter, cleaning the lenses and filling her lamps, is the only woman lighthouse keeper in the United States. Beams from her light, at Turkey Point, Maryland, guide boats into the Susquehanna River channel or up Elk River to the Chesapeake and Delaware Canal.

tidal flats," Maryland's United States Senator Millard E. Tydings had told me in Washington. "Don't fail to look him up." On the back porch of his house we found the 76-year-old guide.

"God's provisionin' was plentiful all about when I was a boy," he told us. "An' many's the time I've seen two men come home at night with 2,000 fowl as their day's shootin'. Wild celery out on these flats drew ducks and geese here by the millions, but times is changed now, and not so many come."

Cap'n Harry recalled how tracks were laid across the frozen Susquehanna in the eighties when a railway trestle burned.

"Passengers got out and walked over," he reminisced, "but the engineer just tooted his whistle and puffed across as unconcerned as if he were rattlin' across Kansas!"

SHELLS SCREAM OVERHEAD

On the run back down the Bay, luck was with us again. The wind shifted to the northeast, just right for us.

Bowling past the U. S. Army's Aberdeen Proving Ground, we were nearly scared out of our wits. Half-ton shells screamed over our heads to fall, with great spurts of flying water, three miles beyond us in a restricted zone. Fish must lead an exciting life there!

We made a perfect run that night. The sky was ablaze with starlight and winds held steady from twilight till dawn. Late on the second day we passed Sparrows Point with its towering steel works and shipyards, then reached up the Patapsco (page 382).

Soon Baltimore's tall buildings came into view and then star-shaped Fort McHenry, still bristling with cannon (pages 383 and 392). Whitecaps were flashing as we sailed over the spot where Francis Scott Key, detained by the British, wrote amid the roar of battle "by the dawn's early light . . . our flag was still there."

At dusk we docked at the Maryland Yacht Club, where sailing members made us welcome.

Next day Baltimore's port captain took us water-front sight-seeing in a city launch. "This month," he said, "ships cleared here for 46 foreign countries and scores of coastal ports."

Although Baltimore today is a great

Photograph by A. Aubrey Bodine

SUMMER TIME IS WATERMELON TIME ALONG THE CHESAPEAKE

Characteristic of Baltimore is this dockside scene of rapidly disappearing cargo delivered to market by wind-propelled schooners and bugeyes.

manufacturing and educational center, her charm to lovers of the sea comes from the traditions of her shipyards and the famous clippers that made her name known equally in Canton hongs and European counting houses.

Those were the days when the scents of gin, nutmeg, cinnamon, almond, and tobacco mingled with the smell of tar and the salty air around the docks; when daughters of merchant princes lifted hooped skirts over mud puddles in the main streets, and gilded bowsprits of famous Baltimore clipper ships peered into dockside windows.

Streets were alive with sailors. Shipmasters, pilots, owners, underwriters, buyers and sellers—all flocked to Baltimore town.

Modern commerce has not destroyed the lure of the water front, although foreign flags along her docks today fly mainly from steel-hulled freighters. Ship chandleries and second-hand stores are still filled with goods reminiscent of the sailing era. Old men and young loiter on street corners gossiping of ships in port and chances for "landin' a berth" in salty terms their fathers or grandfathers would fathom.

Privateering played a big part in Baltimore's early life. Around 1795, while Britain and France fought, some 45 vessels manned by Marylanders but flying the French flag played havoc with English shipping from Antwerp to Genoa, reaping rich harvests of loot destined to become the foundation for many family fortunes.

During the Revolution Maryland citizens equipped and sent out 248 privateers. It was still a profitable venture when the United States and England fought in 1812.

Captain Jonathan Hightower of His Majesty's Navy acknowledged their effectiveness when he was rebuked by the British Admiralty because he had taken so few prizes:

"What can I do?" he retorted. "The Chesapeake's a nest of pirates!"

Not content to rest on past nautical laurels, Baltimore-built ships of the air are now winging their way across the Pacific to Hawaii, the Philippines, and China. While we sailed around the harbor a giant airplane destined for Soviet Russia's use was launched with a roar.

On his first voyage, Captain Smith loitered three days where Baltimore now

Photograph by A. Aubrey Bodine

DAUGHTERS OF THE OLD WORLD PREPARE A NEW-WORLD DISH

Polish and Lithuanian women deftly slice juicy corn from its cob at a Baltimore canning factory. Aboriginal Americans showed colonial settlers how to increase production and quality of "maize" by planting fish as nourishment for seeds. In the background tomatoes are also being prepared for the cannery. Such products from Bay farms are brought to Baltimore factories from plantation wharves by small craft, many propelled by sail alone.

Photograph by H. Robins Hollyday

FERTILE ISLANDS ALONG THE CHESAPEAKE WERE SOURCES OF COLONIAL FOOD SUPPLIES

The numerous waterways of Maryland's Eastern Shore are still the main "highways" for transportation of island produce. Many private estates along the Chesapeake's shores are entirely surrounded by water. In the center lies Wye Island, with Eastern Bay and Kent Island beyond.

stands, and so did we. But time pressed, and when a powerboat offered a tow downstream to Bodkin Point and the Bay, we accepted gratefully.

Favorable winds carried us south to the Magothy River that afternoon. We cautiously worked our way around a fleet of racing star boats as we put into Gibson Island, home of one of America's outstanding yacht squadrons (page 368).

Gibson Island was sandy farmland until recent years when a Baltimore sportsman visualized its advantages as a yachting center. A rambling clubhouse now serves as a splendidly appointed home for sportsman skippers. Summer residences peep bayward through stately pines.

In the landlocked harbor on Saturdays and Wednesdays, dozens of "midget" skippers from five to fourteen years old race 11-foot one-design sailboats and 16-foot Barnegat Bay "sneak boxes." Sizes of skippers and craft are no gauge for their cunning at the tiller or the seriousness with which they follow the racing rules (page 381).

RACING TO HAMPTON ROADS

Sails were being bent on booms and there was much activity aboard larger yachts the afternoon *Tralee* was maneuvered up to the boathouse dock. "What about coming aboard for a race to Hampton Roads?" 40-foot cutter *Binker's* skipper called out. "We need another man to crew."

Hastily assembling a seabag of extra togs, I left *Tralee* in Mate Bob's charge and climbed aboard. Twelve sleek craft tacked

Photograph by A. Aubrey Bodine

MOUNT VERNON PLACE IS BALTIMORE'S TRAFALGAR SQUARE

This oldest city memorial to George Washington, dating to 1810 when the Maryland Legislature authorized a lottery for its erection, gave the State's metropolis its nickname, Monumental City. To the right of the 188-foot Doric column flies Maryland's black, red, and gold flag, one of the oldest insignia now used in the world, flown generations before the Stars and Stripes. Farther to the right, through the wrought-iron grillwork, for which the city is famed, is the Peabody Conservatory of Music, and to the left is the Florentine Walters Art Gallery, containing unique ceramics, ancient armor, and lacquer pieces.

southward bound for Norfolk when the starting gun boomed off Mountain Point that evening at six o'clock.

Silently through the night *Binker* split the waves, while searchlights from ships of many nations made spectres of white sails as the fleet raced down "our sea road," as Baltimore skippers proudly call the Bay.

A few yachts hugged the Bay's shallow western shore and dodged through lines of fish traps—continuous nets sometimes 500 feet in length—as a short cut. Our skipper took no chances, but stayed beyond the steamship channel to minimize dangers of fouling nets or going aground, as some of our competitors did.

Before sunrise the second morning we picked up the light marking the finish at Hampton Roads. The race committee was greeting us from the deck of a tug at the line when we saw other sails peeping over the horizon. Through a megaphone came welcome news: "You're first of your class to finish!"

Late the next afternoon, after my overland return to Gibson Island, we were off on John Smith's tracks again.

Tall radio masts of the high-powered Naval Radio Station towered over us as we rounded Greenbury Point and turned into the Severn River to anchor in the United States Naval Academy boat basin (page 384).* There Midshipman Gordon Gayle greeted us from a dock closely packed with amphibian planes.

"You're just in time," he said, "to see a gang of plebes initiated into the intricacies of sailing."

A hard-boiled bosun shouted instructions at the first-year men making sail with a landlubber's awkwardness. "Watch yerselves on them slippery decks," we heard him growl. "Not that I give a tinker's, but yer parents may object if ye get wet!"

Boys from inland States whose previous nautical experiences were confined to bathtubs or swimming pools spend four years in intensive training here and are graduated capable of assuming junior officer duties in the fleet.

In 1842 Midshipman Philip Spencer, son of Secretary of War John C. Spencer, was hanged at sea from a brig's yardarm for conspiracy to mutiny. Newspapers of that day pointed to the absurdity of using the Navy as a reform school for incorrigible youths. Public agitation was successful; the U. S. Naval Academy was founded in 1845 at Fort Severn.

* See "Annapolis, Cradle of the Navy," by Arthur A. Ageton, in NATIONAL GEOGRAPHIC MAGAZINE, June, 1936.

STATE CAPITOL: WHERE WASHINGTON RESIGNED HIS COMMISSION

With Midshipman Gayle as guide, we explored the narrow streets of colonial Annapolis. In the State Capitol we saw the room where General George Washington resigned his commission as Commander in Chief of the Continental Army.

"Washington's diary records numerous visits to Annapolis," a State official said. "In those days this was a busy seaport and great wealth was concentrated here, based upon rich tobacco lands, cheap labor, and a high level of cultivation sustained by close contacts with Europe."

That afternoon we strolled over St. John's College campus to see the "Liberty Tree," a tulip poplar estimated by some to be 600 years old. Under its branches Virginia Puritans whom Lord Baltimore welcomed as colonists smoked peace pipes with Susquehanna Indians in 1652.

We had been following John Smith's course 21 days actual sailing time. Unusual luck had been ours; only five days had been spoiled by rain. But fortune was against us here; we were stormbound two days. Finally we donned oilskins and sailed out to make the best of the bad weather.

Running wing-and-wing before the wind past the chalky white cliffs of Maryland's western shore, we came to the wide mouth of the Patuxent River, birthplace of fine Bay craft from colonial times.

Here in the sheltered harbor off Solomons Island (large and deep enough to hold the navies of the world, the natives boast) planters and early shippers came, to have Patuxent men build their bugeyes, pungies, and skipjacks. The bushel was measure for craft sizes—"to carry 800, or 600, or 300 bushels of oysters," they'd say—for tonnage was unknown or disregarded.

Boatbuilding is not a forgotten trade at Solomons. In a busy shipyard we saw sleek new schooners and cutters, fitted with the latest chromium gadgets and streamlined masts and booms, ready for launching.

"The hurricane of '33 unearthed grim reminders of early oystering here," a local fisherman said. "When waves washed soil off a small island in the harbor we saw skeletons of murdered men who, years ago,

Photograph by William Smith

GUNS LIKE THESE SAVED BALTIMORE IN 1814

Through the late afternoon and early evening of September 13, British ships poured a heavy bombardment of shot into Fort McHenry. When darkness fell, American General George Armistead temporarily silenced his guns. Thinking the fort was demolished, the besieging fleet moved closer. Suddenly a devastating fire from the fort wrecked many vessels and compelled the fleet's retreat. Detained by the British, Francis Scott Key penned *The Star-Spangled Banner* while ". . . the rockets' red glare, the bombs bursting in air, gave proof through the night that our flag was still there!" General Armistead's statue looks across the harbor to the Union Shipbuilding Company docks (page 383).

had been thrown overboard from oyster boats at the season's close in order that wages would not have to be paid. Captains reported their deaths as caused by swinging booms, and thus the expression 'paying off by the boom' became a colloquialism in the Bay Region."

UP THE POTOMAC, "BLOWING HOME"

At Point Lookout, where the Potomac flows through an eight-mile-wide estuary into the Chesapeake, we tied *Tralee* to a pier and went ashore to tramp over marshy ground where 20,000 Confederate prisoners were quartered in tents through hot summer days and winter gales, and where fevers and pneumonia mowed down men more effectively than guns. Weeds waist-high are growing over trenches, still easily discernible, where Union men defended the Point against Confederates sent by Lee to effect the prisoners' release.

We were casting off our mooring, ready to turn up the Potomac toward Washington's Corinthian Yacht Club and home, when a squall-filled cloud reared its threatening head over Virginia's Eastern Shore across the Bay.

"Let's make it blow us home," Mate Bob dared, and so we turned upriver, the sou'easter sending *Tralee* plowing through a spray-lined furrow.

LIFE'S FLAVOR ON A SWEDISH FARM

From the Rocky Hills of Småland Thousands of Sturdy Citizens Have Emigrated to the United States

By Willis Lindquist

With Illustrations from Photographs by the Author

ABOVE the plains of southern Sweden rises the highland Province of Småland, a rocky plateau which at one time, thousands of years ago, was an island in a nameless sea.

Comparatively few Americans visit Småland; yet it has closer ties with the United States than any comparable area in the Scandinavian countries, since this rugged region is virtually the fountainhead of Swedish emigration to America. From its steep gullies and rocky slopes have come approximately one-third of the Swedish emigrants to the United States—almost two hundred thousand in all.

Centuries of hard struggle for a living are deeply graven upon the mold of life in that out-of-the-way province, and if there is any place where the spirit of old Sweden still lives on, I felt it must be in the "outback" of Småland (map, page 396).

ELECTRICITY FROM RUSHING STREAMS

After making arrangements to stay with a farmer living in that region, I set out from Malmö, the southernmost seaport of Sweden (page 401). An electric train bore me northward over the rich plains of Skåne that sweep onward and onward like a green, rolling sea to the far hills of Småland.

It was late afternoon when I arrived at the little village of Horda. There a brother of my host introduced himself and led the way to a car he had hired to take me the remaining five and a half miles to the farm called Högakull. Every Swedish farm has a name. Högakull means "high little hill."

My new acquaintance was known as the "Director," having acquired his title as directing manager of one of the many local electric power plants along the rushing streams.

"I am leaving my bicycle in town," he remarked as we climbed into the motorcar. "I can get it another time."

I asked him if there were many automobiles in Småland.

"None of the ordinary country folk has a 'bil.' Such things are only for the town people, the business men, and of course those who live in the manor houses." *

The narrow gravel road turned left after passing a few houses and dipped into a lowland of bogs and fields that had once been a lake bottom before the advent of drainage ditches, crossed the flat, and leaped into the cool shade of timbered hills. Large neat stacks of split logs and gray piles of sawdust lay here and there along the side of the road.

We met a man on a bicycle who drew over to the edge, got off his wheel, lifted an old battered felt hat to us, and stood there watching with open curiosity until we were lost in the bend of the road.

At intervals the forest opened to small rugged patches of field. The thick stone walls about them, made of stones from the fields, twisted and turned over the slopes like giant gray caterpillars. We clattered over small bridges with swift streams below them, saw flashes of blue lakes through screens of leaves and branches, then finally turned into Högakull.

GREETED WITH CAKES AND COFFEE

Near the foot of the barnyard stood an old thatch-roofed barn, gray and beaten with age. Close by was a mossy open well with a pail above it. And then, as we drove through a leafy arch between tall maples, we saw the farmhouse, the tool shed, and a new barn, all painted a bright red with white trimmings. Flowers were blooming in the garden and around the house.

The farmer, Carl Johansson, in a blue cotton tunic and rubber boots, came to meet us with a grin (page 395). He had little to say, but fairly rushed me to the coffee table. There were five or six kinds of cookies and tarts and two kinds of cake. The farmer's wife, Jenny, wasn't satisfied until I had tasted them all. Modest, shy, she had the peculiar faculty of blending with the shadowy corners of the room so that you hardly knew she was about.

* See "Country-House Life in Sweden," by Amelie Posse-Brázdová, National Geographic Magazine, July, 1934.

THE SWEDISH NATIONAL PASTIME—COFFEE DRINKING

On ordinary days coffee is served at breakfast, at eleven in the morning, at one o'clock dinner, and at four-thirty in the afternoon. The coffee is weak; sugar and cream are used generously. Six or seven kinds of cakes and cookies are essential. The author remembers having fourteen cups in one day. Here an extra session is held upon the arrival of afternoon guests. Immediately behind Jenny, the farmer's wife, at right, sits the "Director" (page 393), now almost a member of the family. At the other end of the table, in the checkered dress, is Lisa, the daughter of the house.

There were flowers on the table and flowers in my room, but the one thing that caught my eye more than anything else, that first day, was the immaculate, whitewashed open hearth in each of the living rooms (page 398).

These fireplaces were different in style and shape from any that I had ever seen, and in their recesses, hiding the black stones, were neatly woven screens of fresh juniper boughs that seemingly washed the air with a faint fragrance of medicated purity.

SHOES PARKED AT THE DOOR

The cleanliness of that house! You would have been tempted, as I was, to leave your shoes at the door and walk about on the long rag rugs in your socks. That is what the farmer and his family do.

But then, none of them has any shoestrings to untie. Their clumsy-looking wooden-soled shoes fall from their feet almost automatically as they mount the steps, unless, of course, it happens to be Sunday, when they wear ordinary leather shoes with laces and don't bother to take them off. Usually you can tell who is home by the shoes at the door.

When coffee was over, Lisa, the 16-year-old daughter, and her brother, Per, 18, were presented with stiff formality. Except for the curtsy, Lisa, with her freckled face, red bobbed hair, and cotton print dress, might have been an American farm girl. They were both extremely shy and seemed eager to get to their milking (page 397).

The Director and I went to the top of the hill overlooking Lake Rymmen and he pointed to a dozen or more small islands where pines grew as thick as the bristles on a brush.

"Twenty years ago those islands were nothing but barren rock heaps," he said. "The Swedish Forestry Commission ordered us to plant trees on them. We did so. Now they instruct us to thin the trees out from time to time as they grow."

During my stay at Högakull the Director spent much of his time in the forest, clearing away stunted trees and brush. The real work of cutting timber for the market doesn't begin until snow falls, when the logs

HÖGAKULL'S MASTER, SICKLE ON SHOULDER, GREETS HIS GUEST WITH A GRIN

Carl, the author's host, has an odd way of laughing way back in his mouth. He loves to repeat ghost stories he heard as a child, and is something of an artist at description. "Why, do you know," he says, "the road through the woods used to get so black in those days that if you were to stick out your tongue you couldn't see to get it back in again. Yes, yes, so it was!"

can easily be moved with sleds to one of the many sawmills along the railroad track.

The importance of those timbered hills and islands to the people of Småland is more easily understood in light of the fact that almost fifty per cent of Sweden's exports are forest products (timber, pulp, paper, and so on).

ABANDONED FARMS RECALL THE RUSH TO THE UNITED STATES

During the next few days, while Per and his father were busy with the last crop of hay, and Jenny and Lisa were canning raspberries, red currants from the garden, and wild lingonberries and blueberries that grow everywhere on the wooded hillsides, the Director took me for long walks through the hills.

We tramped along irrigation ditches which convert large areas of swampland and sour bogs into fertile fields, and over narrow winding paths through pine forests.

More interesting than the forests themselves were the occasional clearings, thick with underbrush and tall weeds. In some of them were ruins of small huts and depressions that had once been wells.

A chapter of our American history is written in many of these lonely places. At the turn of the century thousands of farm folk in the hills of Småland were struck with "Amerika fever."

Families struggled for years to save enough money to send one of the children to the United States; he or she in turn sent money back to the others, until finally there were none left but the aged parents. When they died, their huts quickly fell to ruin and the forest slowly engulfed the small fields.

HATS OFF IN COURTLY SALUTE

On these walks we often met people on bicycle or on foot. When that happened, both the newcomer and the Director would take their hats off by way of salute. If I were to remove my hat in the same manner to an American woman, she would accuse me of rank sarcasm. It isn't merely a matter of tipping the hat. Each man takes it off completely and swings it down in a wide arc to the level of the hip. I've often wondered how they manage in a snowstorm.

Drawn by C. E. Riddiford

FOUNTAINHEAD OF SWEDISH EMIGRATION TO AMERICA IS ROCKY SMÅLAND

Here the author, an American, came to visit the uplands where his father was born. Some 200,000 sons and daughters of Sweden, about one-third of those who have made new homes in the United States, were born and brought up in this rugged agricultural region north of Malmö (page 393).

A typical conversation at one of these chance meetings goes somewhat like this: After the proper introduction the neighbor says, "Oh, so you are the American who gets so much mail."

"Yes."

"How do you like Sweden?"

"Very much."

"That trip across the ocean, it must be a terrible thing."

"No, not so bad."

"Let me see, to come to Sweden you only have to cross one ocean?"

"The Atlantic, and then there is the North Sea."

"Oh, well, that little pond!"

COFFEE CAPACITY LIMITS CALLS

Frequently, too, we stopped in to greet families who lived along the way, but, owing to our limited endurance as coffee drinkers, there were never more than four such calls in any one day.

No matter what time we happened to come, coffee was always the first thought of our hostess. Under the social code of Småland she would have been most impolite had she not invited us to coffee, and we, on the other hand, would have been equally rude had we refused.

In many of the houses we visited, the living room served also as the bedroom, the unique folding bed shoved against one of the walls usually being covered with a bright-colored afghan. American calendars and whiskered ancestors in large gilded frames are the principal wall decorations and it is not uncommon to find a huge grandfather clock standing in one of the corners.

WRESTING A LIVING FROM ROCKY FIELDS

One busy day followed another at Högakull. When the hay crop was in, Carl, armed with a sickle, went into the yellow, waving fields of grain. He cuts his hay and his grain exactly as his father and grandfather did before him. Lisa and Per followed as he cut, picked up the grain, and tied it into sheaves that were later threaded on uprights.

The small fields would not warrant the purchase of modern farm machinery, but even if such machinery were given to the farmer as a gift it could not be used on most of the fields of Småland because of the number of rocks and bowlders. It takes a skillful hand with the sickle to avoid them as it is (page 397).

You might well imagine from this that the farmers are a lazy lot, keeping their fields in such a state, but that is far from the case. It is difficult for one who has never seen Småland to visualize a place where the very surface of the earth looks more like an endless series of rock piles than anything else. These rocks are the discouraging factor which drove thousands of Swedish people to emigrate to the United States.

Breaking new land to the plowshare and clearing it of rocks is an endless task. Only two or three of the oldest fields at Högakull are rock-free (this does not mean stone-free, as stones up to the size of an egg are an inherent part of the texture of the soil) and yet, winter after winter, tons of granite are blasted from the earth, placed upon skids, and hauled out upon the frozen lake where it is left to sink to the bottom when the ice melts (page 402).

During the bright days of harvest, when the kitchen had taken on the aspect of a cheese factory, a white linen tablecloth was spread over the table in the shade of the large elm and at 11 in the morning and 4 in the afternoon Jenny's thin voice, sounding the call to cups, floated over the land and echoed faintly in the hills.

LISA, DAUGHTER OF THE HOST, PEELS POTATOES IN THE BACK YARD

If a stranger should come along, this shy girl would quickly disappear into the kitchen and stay there. Upon being introduced, she curtsies and finds some excuse to hurry away. Like all sisters, she loves to tease her brother, Per.

SOMETIMES THE SMALL HAND SICKLE IS USED AT HÖGAKULL

Grandfather's curved blades are still kept in good order. The going may be slow, but in some fields the stones are so thick that the hand sickle is still the most efficient implement for cutting grain.

A SELDOM-USED OPEN HEARTH IN THE PARLOR AT HÖGAKULL

During cold weather the parlor is usually closed up, to conserve fuel. Therefore the pasteboard cat hasn't been disturbed by heat for years.

The farmer frequently came in from the field with a small sheaf of wheat or rye tucked under one arm. Between sips of coffee he would sit back and count the number of kernels on each stalk with the point of a penknife to select those heaviest with grain for next year's seed. On those rocky fields of Småland no trick in the science of crop culture can be overlooked.

RIGHT CHURCH, WRONG PEW

Never shall I forget my first visit to a Swedish church. Lisa and I went to the one at Rydaholm. The white walls of the antechamber were hung with old relics of nobility and in one corner were wooden stocks which imprisoned the ankles. The stocks used to stand at the entrance, when occupied, so the parishioners might see the sinful ones.

We were late and the church was well filled. I followed close upon Lisa's heels and sat down beside her. Strange, I thought, people kept looking at me from all sides, long after natural curiosity should have been well satisfied. I began to do some looking myself and suddenly realized that the old system of women on the left and men on the right still prevailed. I was seated with the women, the only man left of the center aisle!

The Director later took me up into the tower of the church so I might see how church bells are rung by foot. A huge wheel with a treadle was coupled to the bell by means of a short shaft, and the ringer, who stood at one side of the wheel, rang his bell by stepping upon the treadle each time it swung back.

Unlike most church towers in Sweden, the one at Rydaholm has two peaks. This, according to the Director, was because of the unusual dimensions of the tower itself, which was built long before the Reformation as a watchtower. At that time Småland was a buffer state and the scene of many battles between Sweden and Denmark; for the southern part of Sweden was then in the hands of the Danes.

As we left the church, the Director explained that the small buildings in a row across the way were the horse stables for churchgoers. He smiled suddenly.

"They used to sell strong drink right here on the church steps after the service. That was to make the blood sing in the veins during the long, cold ride home through the snow."

Like other Sunday afternoons, this one was spent with company over coffee, and more coffee. Whenever a group of Swedes gets together, the conversation invariably turns to people and families. On the strength of what I heard at such conversations, I think the average Swede has a more intimate knowledge of distant cousins, great-aunts, and step-nephews than any other people on the face of the earth.

Possibly the explanation of this flair for names and relatives is to be found in the extraordinary importance placed upon the family as an institution. Every festival, every national holiday or local celebration, every church function, is first of all a family affair. The family group constitutes the very nerve center of society and that, I think, is the rock upon which modern Sweden is built.

SWEDISH COSTUMES OF OLD HAVE LARGELY BEEN SUPPLANTED BY THE GINGHAM GOWN

In some far-flung hills of Småland, time has a way of standing still and it is as easy to walk into the last century as it is to walk across the street. Girls like this one, who go alone into the hills to milk the cows, come back sometimes with extraordinary tales about the little dwarf who mysteriously appears to help with the milking and then vanishes.

It was a month before I really became accepted as one of the family at Högakull and was permitted to dine at the family table in the kitchen. Before that, the men had been eating with me in the living room while Jenny and Lisa remained in the kitchen.

KITCHEN THE KEY TO FAMILY LIFE

Much of the small house was locked to me during those first weeks and I felt very much as if I were staying at a small hotel. But once I was welcome in the kitchen I could at last join in their small talk, and, what was equally interesting, the small talk of the bewitching old lady who comes three times a week for milk. She pays two or three cents a quart for it and gets coffee every time she comes.

Every variety of cookie and cake in the pantry is heaped upon the old lady's plate, and if she isn't able to eat them all, which happens frequently, Jenny wraps the rest

BEAUTY AND THE MECHANICAL BEAST

Although she is a Småland country maid, her bobbed hair and sport dress give her the flash of a Stockholm girl. The lightweight motorcycle is the type most commonly seen on the narrow roads of Småland.

ROCKS DON'T DO THE SCYTHE ANY GOOD!

Wherever a farmer is cutting hay or grain, a crude sort of stool, a pail of water, and a whetstone are near at hand. Frequent halts are necessary to resharpen the blade, dulled by the ever-present stones.

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THE EARL OF BOTHWELL, THIRD HUSBAND OF MARY QUEEN OF SCOTS, ONCE LANGUISHED IN MALMÖ'S ANCIENT CITADEL

A network of canals has replaced the strong fortifications which surrounded Malmöhus Castle (center) in the days of the Hanseatic League. Southernmost port of Sweden, the city is less than 20 miles from Copenhagen, across the sound. It ranks second only to Stockholm as an industrial center.

THE ENDLESS TASK OF TAKING ROCKS FROM THE FIELDS LASTS ALL WINTER

In the fall the bowlders are lifted by hand derricks and dragged to the edge of the field. When snow comes they are placed upon skids, hauled far out over the frozen lake, and left there to sink when the ice melts (page 396). Rocks found balancing upon the surface gave rise to tall stories about giants, who were in the habit of throwing them many miles in moments of wrath.

of them in a paper and has her take them home. Charging for the milk seems to be little more than a technicality.

Coming back to the small talk, it isn't so much what the old lady says as how she says it. She exemplifies a trait so often found in those women of the pines and hills, a peculiar habit of making a flat statement and then, as if fearing contradiction, whittling it down with one qualification after another until the entire effect is negative.

As we were having coffee one morning, the old lady told about a trip she had once taken, and finished off with, "The scenery up at Nydala is very, very beautiful."

There was no answer to that, no sound but the sipping of hot coffee from saucers, and perhaps she took the inverted hissing to be reproving. Anyway, she went on, "Yaaaaaaa—not nicer than other parts of Sweden, of course, but it isn't ugly to look at. I'll say that."

With the exception of the small sales made to the old lady, Carl never sold any of the milk from his six or seven cows. Jenny made use of it in a number of ways in cheeses, butter, and a variety of puddings.

Carl's primary interest was veal. When he had several calves ready to sell, or some sheep or pigs, he took them to one of the farmers' fairs which are held as often as once a week at Värnamo.

Per and I pumped our bicycles about fifteen miles to attend one of them. It was half carnival, half a rustic marketplace.

Long rows of temporary stalls sold everything from dresses to cabbages. There were ice cream shops, quick-lunch counters that made me think of hot-dog stands, side shows, a merry-go-round blaring forth American jazz, a fast-talking peddler selling canes, fancy hats, and pins. He craved our indulgence because he had to support a "two-legged cat."

LISA WASHES DISHES AT THE KITCHEN STOVE

The small iron range is in the hollow of what once was an open fireplace. The dark door beyond the hand of the daughter of the household opens to an oven that hasn't been used since the stove was installed. Note the indispensable coffee grinder (second from left) on top of the mantel.

"PUTTE," VETERAN FARM HORSE, IS MORE AT HOME PULLING A PLOW

For 23 years the animal has been a faithful member of the family at Högakull. Saddles have seen little service in Småland since bicycles gained favor.

BIRCH-BARK DISK ON SCYTHE HANDLE NEATLY LINES UP THE GRAIN

When the reaper cuts the stalks, they fall against the disk in an even row. With a twist of the wrist, the cutter deposits them on the ground, all the heads pointing in one direction and ready for the binder (background). To use modern machinery on the rocky hillside fields of Småland is, in most cases, impossible.

TOMORROW IS SUNDAY—CARL FEELS HE MUST KEEP UP WITH THE SWENSONS

The horse buggy is still the usual form of conveyance on short trips to church or to some coffee fest on Sunday afternoon in Småland. Such is about the extent of traveling done by the family. The farmer and his son and daughter have bicycles which they use upon lesser occasions. Hay under the back seat is lunch for the family horse, "Putte" (pronounced "Put-tee").

Behind all this was the animal market where horses, oxen, calves, sheep, and pigs were calmly being bought and sold within small knots of men.

BARGAINING AT A FARMERS' FAIR

There was no coming down to brass tacks at that market. Purchaser and seller started out with the weather, then politics, and kept avoiding the subject at hand. Time meant nothing, and no matter how eager a man might have been to buy a certain horse or cow, he never let on that he was more than mildly curious.

The man who owned the beast made it clear that he wasn't particularly keen about selling such a fine animal, unless, of course, he could get a very fine price for it. Likely as not it was a case of no sale, but if one did occur you got the impression that each was doing the other a decided favor.

Second only to the market as a social institution are the unique open-air museums found in every province of Sweden. They take the place of public parks and picnic grounds, on the one hand, and museums on the other.

These museums are relatively new as the history of Sweden goes, dating back only about sixty years to the time when Dr. Arthur Hazelius started his collection of everyday articles of Swedish country life. He felt that each piece had a special significance which could be appreciated only if it appeared in its proper setting.

He hit upon the idea of furnishing old homestead buildings with them, each item in its related place, creating an exact picture of a rustic home of perhaps a century ago. This led to the establishment of Skansen, famous outdoor museum of rural arts and crafts at Stockholm.

The idea caught on quickly in other parts of Sweden. Neighborhoods were awakened to their own particular variety of provincialism and were eager to preserve it from modern standardization. Local societies were formed, open-air museums established, and interest in the work stimulated by lectures and social evenings.

We went to one of these *gammalgårdar* (old farms) one Sunday afternoon. It was miles from any town, having been established on an old homestead back in the

SMÅLAND'S BELL TOWER STILL SUMMONS WORSHIPERS

Once the tall wooden structures were common throughout Sweden. Their design was inherited from the Middle Ages and they were countryside ornaments in their own right, for they were built separately from the church edifices. This unpainted, shingle-covered tower, which stands by the side of the Öjaby Church 20 miles southeast of Horda, is a much-prized relic of a day that has passed.

hills. On a clearing at one side of the old buildings, temporary benches and a platform had been erected. During the afternoon there was a band concert, a lecture by an official from Stockholm, a short play, and, by all means, coffee and ice cream.

But more interesting than all that was the museum itself. The main room of the house was a combination kitchen, living room, and bedroom, with a great open fireplace in which kettles were hung from hand-forged cranes; there were two-story bunks against one of the walls, unique oil lamps, rude tables, wooden bowls and plates, a candle-making device, and a spinning wheel.

THE ALMS BOX IN FRONT OF ÖJABY CHURCH RESEMBLES A SMALL SAFE

Småland churches still observe the old custom of seating women on the left side of the center aisle and the men on the right (page 398).

At the entrance to one of the smaller buildings sat an old man in provincial costume making wooden shoes, and at odd moments during the afternoon a quartet in knee breeches and red or green stockings sang folk songs to the accompaniment of an accordion.

I looked in vain for one of the old Viking rune stones. For some strange reason the sponsors had not seen fit to acquire one of those graven stones that lie about the countryside. I have seen several of them among the rock heaps at the side of the road, one, in fact, not a mile from Högakull; yet rarely is any attention paid to them.

Toward the last of September, when all the sheaves of grain had been stored in the loft to await the diminutive thresher, the farmer, Per, and I dug potatoes, Lisa and the old lady who buys milk joined forces to clip the sheep (page 412), and Jenny washed the wool and spread it on racks to dry in the sun and wind. The autumn days were typically crisp ones with the smell of wood smoke in the air, for somewhere in the hills the Director was gathering and burning large piles of brush.

As the days grew shorter the men came in from the fields earlier and supper was served about 8 o'clock instead of 9 or 9:30 as it is in the summer. This meant evenings

HAY IS A LARGE AND IMPORTANT CROP ON THE SWEDISH FARM

Farmers cut their hay several times each summer—heavy and good cuttings, too, because of the frequent rains. Still there is never enough for the long winter, so it becomes necessary to feed chopped-up grain straw as a substitute. The thatch roof on the old barn is covered with gray moss.

by the kitchen fire, not unlike the evenings spent on many American farms. Jenny usually picked up her knitting. Lisa read love stories, while Per, always practical, turned to the farm journal or thumbed through a mail-order catalogue. The daily paper from Stockholm was more to the taste of Carl and the Director.

Lisa and Per sometimes visited friends or had company during the evenings, but that was about the extent of their recreation. The nearest movie was miles away and dancing was looked upon with disfavor.

Although Högakull had the only radio that I remember seeing in a farmer's home, it was seldom used during the evenings unless an important political speech was being broadcast. The radio stations are operated by the Government. There is no advertising and the programs consist of lectures, dramatic skits, and music, from American swing to Wagner. There is a good variety of programs to choose from, since a turn of the dial brings in stations from all over Europe. The radio is on during the breakfast hour, when the farmer listens to the weather report and the news broadcast.

The only other modern notes about the house are the electric light and the American cream separator.

Like most rural houses in Småland, the one at Högakull is actually a log cabin. The logs are squared and the chinks filled with plaster or reindeer moss. Plaster

THE SPINNING WHEEL'S HUM IS SELDOM HEARD ON THE FARMS OF SMÅLAND

Only the older women care to bother with spinning in modern Sweden. They spin yarn for heavy mittens, stockings, socks, and mufflers, and spend the long winter evenings by the fire with their knitting. Like most of the other dwellers in the hills about Lake Rymmen, this housewife covers her unpainted plank floors with long rag rugs.

covers the inside walls, with paper over that, and on the outside, 10- or 12-inch planks are nailed vertically, each crack being covered with a narrow strip of wood.

COWS HAVE ELECTRIC LIGHT AND INDIVIDUAL DRINKING FOUNTAINS

Although not so large, the barns are built very much like those in the United States. The new one at Högakull has as many windows as the average American home. It has cement floors, separate drinking fountains in every stall, and is lighted by electricity that comes from the powerhouse by the rapids not a mile away.

Still another note of the modern age has crept into the rhythm of life on that Småland farm. The drone of an airplane flying overhead can be heard several times a week. It is the passenger service between Stockholm, Malmö, and Copenhagen.

Tagel is the site of the only manor house in the immediate vicinity of Högakull. We were entertained there one day by Gustav, who has charge of the dairy barn and the cows. He milks the cows with an American milking machine.

Each tenant on the estate is a specialist of one sort or other and is furnished a two-room house with a small garden. He gets a small salary, and milk, butter, eggs, fruit, flour, and potatoes from the manor house.

EACH MORNING THE LAKE RYMMEN FISHERMEN HAUL IN THEIR NETS

The average catch is from thirty to sixty perch, pickerel, eel, and pike. A dozen of the best are selected for the table. These are gutted and boiled in dill water, head, tail, scales and all. The scales are left on to prevent the fish from boiling to pieces. When done, the skin almost falls from the flesh and none of the rich flavor of the meat has been lost.

FREQUENT SUMMER RAINS MAKE IT IMPOSSIBLE TO DRY HAY UPON THE GROUND

Four wires are drawn tight along a row of poles to keep the crop off the earth. Hay is hung upon each wire, creating a solid wall that runs half the length of the meadow. Poles and wires are moved from field to field during drying season. It takes one man about half a day to set them up.

SEEDING RYE AS THEY DID IT IN THE TIME OF DAVID

Carl Johansson, master of Högakull, fills a wooden box with rye and then walks up and down the field, casting the seed in fanlike sprays with lightning flicks of his wrist. Though the flying grain (center) is still in midair, the sower's hand has returned to the box for more seed.

In a modest way he seems better off than some of the independent farmers.

Gustav's wife, Alva, who operates a knitting machine for the "big house," served us schnapps and beer and then one of the most typical of Swedish dinners, the main course consisting of pickled herring and boiled potatoes with sour cream and salt.

They had recently sent their 16-year-old daughter to serve an apprenticeship as maid in a minister's house. Such a procedure is fairly common after the girls have finished compulsory school education at the age of 14 and taken the all-important sight-seeing trip to Copenhagen with the graduating class. In a few instances they continue their education in middle school in some near-by town (middle school is about the equivalent of high school), or take nurses' training in one of the county hospitals where persons who are unable to pay may be treated without cost.

Most of the boys seem to take as little schooling as possible and then either continue with farm work or go into city factories.

Life at Högakull has its idyllic moments.

It is the hour of sunset. Per comes from the barn with white-brimming milk pails, leaves them at the door for Lisa, and, swinging three fish nets over his shoulder, leads me down the narrow path to Lake Rymmen.

CASTING THE NETS AT NIGHTFALL

We take the flat-bottomed boat and shove off on the windless waters. Not a breath of air ruffles the surface, blue and crystalline under a sky corrugated with wisps of cloud, and the sun flings its last feeble rays upon the treetops of the island called "Long." We go round it to the large rock and I row slowly as Per plays out the nets.

Over the mirror of water, which is changing from blue to dull gray, and beyond the sweep of shore that bends off toward Horda, lie dark, shadowy forms. They are other fishermen of Rymmen setting their nets by the strange light of dusk.

The whole world seems drenched in calm. I can understand why this last of the day's chores lies closest to the farmer's heart. There is an assuring, entrenched constancy about it, as if this, the most ancient occupation of man, had always been a part of Småland's lakes. Then the distant boats fuse into shadows as night sifts down over the lake like fine dust.

A NEIGHBOR HELPS LISA AND HER FATHER CLIP THE HÖGAKULL SHEEP

Once an animal's feet are tied, it lies perfectly still, as if it enjoyed the operation. Most of the wool is used on the farm or sold in the local community. Woolen mills in Sweden import the bulk of their raw material. Sufficient mutton is raised on the farms to supply domestic demand.

We pull for shore in the strange hush that falls before darkness. There is no sound but the dripping oars and the sloshing water along the sides of the boat. Far off and faint as the sigh of wind in the pines, the cry of a loon comes weird and lonely over the water It stirs soundless echoes within us and we let the boat glide for a time, listening, but it does not come again.

BIRD NOTES GONE WITH SUMMER

Autumn has brought a new silence to the Rymmen. In summer the sounds were the cuckoo's melancholy note rising from the thickets of conifer on rocky slopes at the water's edge, the shrill piping of young seagulls crying for food, the excited twitter of small songbirds in the copse of green cedars, and the screaming challenge of the kite as it wheeled slowly high overhead.

But now, with summer gone and the birch trees changing their leaves into jittery golden tinsel, long silences brood in the sky and water, broken occasionally by the creak of a fisherman's oarlock or the cry of a far-off loon. Except for this, there is only blue space and silence and a small, small voice as constant as the crenelated granite ramparts which flank the shores, a voice as restful as the enchantment of still reeds in the little cove where bass leap for water bugs at sundown—the small, infinite voice of water gurgling among the rocks.

There is a sharp grating of sand against the prow. Per makes the boat fast and goes on to the house while I climb out to my favorite perch on the flat rock. I sit on its cool, rough surface watching as the last light of day is drawn out of the sky and night closes down upon the land. Then, far off to the right, above the end of Lake Rymmen where dark pines on the hills of Tagel hold back the sky, the first star burns over Småland.

For a time there is nothing, nothing but the faint echoes of this land which a stranger can never quite hear, nothing but the ineffable haunting spirit that hangs over the lake day and night.

An aurora grows and pulses against the horizon until the moon, mounting suddenly over the edge of the world, thrusts its light across the lake like the flash of a Viking broadsword. It climbs into the sky, bathing everything in a downpour of silverish-green

THE THREE SMILES BELONG TO SMÅLAND SISTERS

On the Norregard farm, not far from Högakull, lives a man who might be called rich. He has two sons, two farms, a pedal organ, and three daughters. The daughters are, left to right, Svea, Anna, and Nelly. Svea is going to be a nurse, Anna goes to high school, and Nelly, happily past these uncertainties, is working on a hope chest.

wash, and gently lays a path upon the water, a lovely unearthly path as soft as the sheen of velvet.

There is a voice calling my name.

FROM SOLILOQUY TO SAUSAGE

I get up and go toward the house loathing the very thought of such a material thing as food. But as the savory odors of Swedish cooking come to me I know my mistake. Such smells as these can be the masters of men.

They change the complexion of things and I join the family. There is summer sausage, highly spiced fillet of anchovies, pickled herring, strong homemade cheeses, butter balls, rye and barley breads, and milk.

This is only the "smörgåsbord." For the main course there is boiled eel from the automatic eel trap at the rapids, small meatballs fried in onions, country sausage, boiled potatoes and gravy, and, for dessert, a rice pudding served with cream and a fruit butter of lingonberries and pears.

Most Nordics eat almost again as much as the average person, and dinner and supper are serious affairs with little time out for conversation. But when coffee comes there is a sense of enjoyment which seems to demand expression in one form or other.

Lisa asks her father if he doesn't want a third cup and saucer full. He looks at her with the suggestion of a twinkle in his eyes and answers in a matter-of-fact way, "Yaaaaa. I would, but that last cup was so full of grounds it was really quite filling."

We sit at the table long after the dishes have been cleared away and talk of many things. The farmer tells about the old custom of bringing gifts to the minister before he performed a funeral service.

"What was given had much to do with the sermon," he continues. "If the gift was a few eggs, a cheese, or ham, you could depend upon a short service with very little breath wasted talking about the deceased.

"But things were fine if a whole pig was given. Care for us with mercy! Yaaaa. Then the dead would be praised as the perfect man and the mourners had four or five hours of crying and wailing before the

service was over. Yaaaa. So was it in my father's day."

GAME OF GETTING THE GUESTS TO EAT

One of the most amusing things about the old Swedish country life was the way in which the host and hostess of former days had to resort to strong-arm methods to get their guests to eat.

Fortunately, the guests always came, usually with that when-do-we-eat look. The trouble was that at the first mention of food the guests would scatter like so many sheep in a thunderstorm, hiding behind the house, in the shed or hayloft, behind the thinnest tree they could find, or, in fact, any obvious place where they could be easily found.

It was all part of the game. The host and hostess understood that for their guests to come out flatfootedly and accept food at this stage would be worse than crude. Much worse! It would be like asking for it. The host had to go out, find the guests, and lead them in, one by one, and serve them with heaping plates.

Although this custom does not exist in modern Sweden, its present-day sequel is another form of the same thing. I have seen guests who feel they may not properly accept food until the hostess has begged and coaxed them five or six times and made all sorts of excuses for the food.

The nice point about it seems to be that by waiting until the hostess has worn herself out talking, the guest's act of going to the table and gorging himself is accomplished with a certain dignity, as if he were going through with the ordeal out of pity for the hostess.

ORDER OF SERVING MAY CAUSE A FEUD

There are other complications, too. It is customary to serve each guest in accordance with his relative importance to the other guests present. The relative importance may be age, position in life, or, at funerals, relation to the deceased.

Naturally, each guest has his own idea as to where he should come, and if the hostess makes so unhappy a mistake as to call him later—Well! I know of an army officer who thought he ought to come first. The hostess put age ahead of his rank. That was three years ago. He hasn't spoken to the host or hostess since.

One day early in October several small groups of farmers passed along the road with guns flopping against their backs at every step. It was the big day of the annual elk hunt.

That night one of the hunters came on his bicycle to invite us to an elk skinning. When we arrived the men were just coming out of the farmhouse and we knew we had missed coffee by inches.

The three-year-old buck they had killed was taken from the lumber wagon and hung from a rafter in the barn. Four men set to work in the yellowish light of an oil lamp. About them, in the sharp chill of October night, faces of men, women, and children made white blurs against the darkness.

There was the hiss of knives cutting through flesh, and the warm cloying smell of blood mixed with the stench of barn dung. From behind me, in the darkness at the edge of the crowd, came the low buzz-buzz of awed people as each new arrival was told the story of the hunt.

The meat was divided among the hunters and each of them contributed a portion of the tax imposed by the Government for every elk killed. The money goes into a special fund for the compensation of farmers whose crops are damaged by the animals.

Toward the middle of October most of the fall work had been completed at Högakull. The cows had been taken in from the dead pastures and put in the barn. Per had already plowed the fields and some rocks had been dragged to one side. Now he harrowed the earth with the aid of the 23-year-old horse called "Putte," and behind them walked Carl with a box of rye under his arm. He dipped into it at every third step and sent the seed flying in a great fan to the brown sandy soil.

When the dragging and seeding were done, several loads of sand were hauled from the government gravel pit and dumped and graded on the public road that passed through the farm. Other farmers with property along it were doing the same thing.

I left just as Högakull had gotten snug for the winter. On the morning of my departure there was a special send-off breakfast. Everyone was eager to be of help. The family and friends loaded my things into the buggy and stood waving as Putte drew us down the road into a glittering world of white frost and green, silent pines.

"Don't look back," the farmer begged, "because if you do that is a sign you will never come again!"

I didn't look back.

VOL. LXXVI, No. 4 WASHINGTON OCTOBER, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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DOWN THE RIO GRANDE

Tracing this Strange, Turbulent Stream on Its Long Course from Colorado to the Gulf of Mexico

BY FREDERICK SIMPICH

WE SING of *Beautiful Ohio,* or *Swanee River;* but nobody hymns much praise for the Rio Grande—at least not for that long stretch that forms the Mexican-American border from El Paso to the sea. Yet what high adventure this wild, rough region has seen, in all the boisterous years between Cabeza de Vaca and Pancho Villa!

Yet, whether you like to hunt mountain lions, bust broncos, study Indians and ancient ruins, peck around cliffs for mastodon bones, monkey with a captive armadillo—or simply sit in a Mexican cafe, eat tamales and listen to *La Paloma,* you can find your heart's desire somewhere along this extraordinary stream.

Rising on the Continental Divide in southwest Colorado, it flows east, then south, through the Connecticut-sized, 8,000-foot-high San Luis Valley of that State, and continues through steep-walled canyons into New Mexico, wanders across that sunburnt land, and at the western tip of colossal Texas turns lazily southeast to the Gulf of Mexico.

GEOGRAPHIC SURVEYS RIVER'S COURSE

Among all our great rivers, none has such odd aspects, peculiar to itself. Cowboys call it the "world's dustiest river"; robbed by irrigation through three States, it often has little more water in its tired mouth than flows in its cold, aspen-shaded upper reaches. On all its turbulent course, we saw no boats except on the lake formed by Elephant Butte Dam (page 426).

Until the National Geographic Society in 1938 photographed this river, along its whole length, no similar study had been made. Yet anyone can drive his car from the shadows of the Great Divide in Colorado all the 1,800 miles downstream to the Rio Grande's muddy mouth (map, page 419).

On this panoramic ride, by taking a few bumpy side trips, he can gain frequent fine views of the winding river, pass through Indian villages, Spanish-American colonies, and the changing Southwest's last enormous cow ranches—in fact, enjoy a trip surpassed by few in America for profound human interest and majestic scenery.

Start, for example, at Rio Grande Reservoir, formed by the uppermost dam in the creek-fed Rio Grande. At an elevation of nearly 9,500 feet, this artificial lake lies on the wooded slopes of the San Juan Mountains, about 25 miles upstream from the once roaring silver camp of Creede (page 423).

Summer vacation shacks now clutter many beauty spots in southern Colorado, and excited men in hip boots, with sunburnt noses, whip acrobatic trout from pool to pool where once only the bobcats and Indians worried them.

Exploring Spaniards had sought gold and shot Indians here long before the Battle of Bunker Hill; but when Jefferson made the vast Louisiana Purchase from France, in 1803, no white American except Jim Pursley, a fur trader from Kentucky, was known to have seen this upper Rio Grande country.

Photograph by Luis Marden

WHEN FLOODS AND DRIFTWOOD MENACE LAREDO'S BRIDGE, MEN REMOVE ITS ALUMINUM RAILINGS AND LAMP POSTS

No flood is coming now; this demonstration was made to show THE GEOGRAPHIC'S photographer how the job is done in emergency. Over this International Bridge, part of the new Pan American Highway, thousands of American motorists drive annually to Mexico City (Plate XVI and page 447).

Zebulon Pike, marching into the San Luis Valley in 1806, mistook the baby Rio Grande for the Red River, whose source he was seeking. Beaver trappers, following Pike, prowled all these passes and creeks that swell the head of the Rio Grande. Today, beavers, protected by law, are back again and are increasing (page 421).

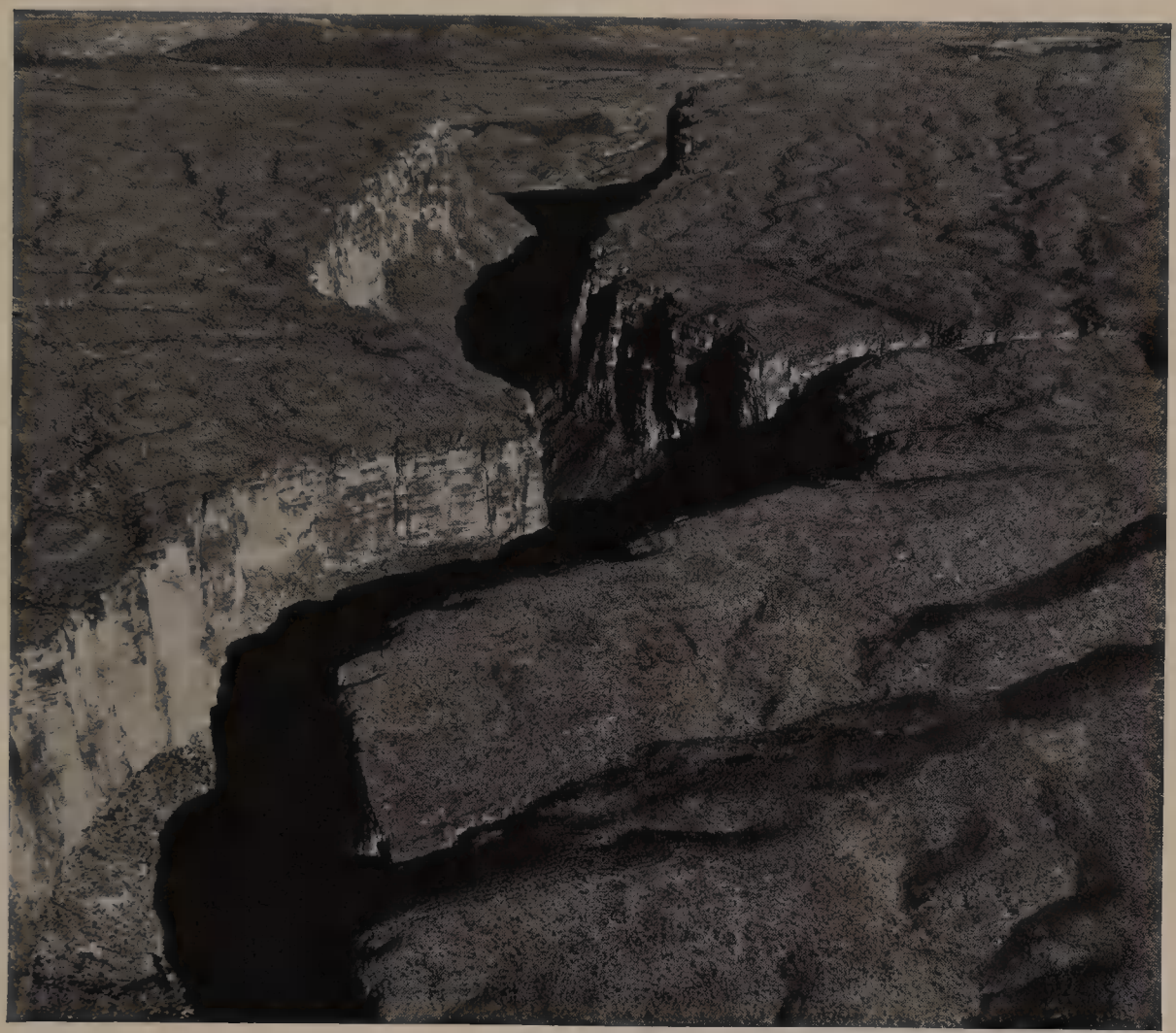
"They're a nuisance," complained one rancher near Creede. "Last spring I was hauling wood and had to ford Rat Creek; one morning when I got there, the beavers had dammed the creek and flooded the place where I had to cross. To lower the water, I tore out their dam. That night they built it again! Next day I tore it out again. I had to tear it out five times before I could discourage them!"

Creede today is only the ghost of its old boisterous self. Into it a railroad train ventures only once a week! In its hurly-burly heyday, Cy Warman, Colorado poet, wrote of it:

> It's day all day in the daytime,
> But there is no night in Creede.

Here hairy-faced miners from all over the globe once sweated by day and fought by night. Today saloons and dance halls are deserted, or torn down; a big one, famous in boom days as "Bob Ford's Dance Hall," is now a garage.

Ford, in my youth, shot Jesse James, notorious Missouri outlaw; later, we heard, "Bob Ford was killed, out in Creede, Colorado." That was in 1892. By odd coincidence, the first man I spoke to in Creede said, "Yes, I knew Bob Ford. I saw Kelly



Photograph by Texas National Guard

DEEP DOWN IN SANTA HELENA CANYON, A DARK, EVIL SCAR ON EARTH'S FACE, TUMBLES THE TROUBLED RIVER

Three such canyons, in places about 1,600 feet deep, form sections of the international border. Mexico here lies at the right; dry, uninhabited mesa wastes at the left belong to vast Brewster County, Texas. At the canyon's mouth, upper center, the river debouches into a valley of ranches and a few cultivated fields (Plate X).

kill him; he got him at ten feet, with both barrels of a shotgun. I have some old photographs showing Ford's funeral—and what a turnout! All gamblers, all dance hall girls in camp were there. And all barkeepers, of whom we had plenty. One saloon was so big and busy, men said, that the barkeepers had to work on horseback."

WHERE KIT CARSON FOUGHT

Most of the diggings, marked by tumble-down shacks, broken iron cookstoves, and rusted machinery, are now abandoned. Today more people live along this upper Rio Grande than in mining boom days; now they're growing potatoes, beets, hay, and raising sheep and cattle.

Downstream from Creede, along the once stony stagecoach trail, now runs a smooth highway; at historic Wagon Wheel Gap, it curves gracefully past the ruined fort where Kit Carson fought the Utes.

Del Norte, Monte Vista, Alamosa, all are bustling Colorado towns, set along this Rio Grande Valley. Each, in its youth, sowed its wild oats. Alamosa was the black sheep, because it was for a time the terminus of the first railway to crawl west over the snow-capped Sangre de Cristo Range and into the San Luis Valley.

With the new road came many of that robustious and predatory breed who later were to dangle at a rope's end as vigilantes did their duty. To the drooping toes of one such bad man, lynched for molesting a respectable woman of the camp, was tied a

Photograph by Luis Marden

WADDY AND RUBY DO A MEXICAN DANCE, "PUT YOUR LITTLE FOOT RIGHT HERE"

Cowboys, cowgirls, lion hunters, country storekeepers, and schoolteachers from all over the Texas Big Bend Country came to Green's Ranch for this party. Mexican musicians "went to town" with swing rhythms like "Mother Goose Is on the Loose," but bogged down badly when they tackled old-time square dance tunes.

placard which read: "Alamosa Pertects Her Wimmin." Strangest of all cargo, on the first train in to Alamosa, were two hotels and a saloon—lifted and moved by rollers onto flatcars at another town back up the line—over which the boom had swept!

Glistening Alp-like peaks fairly hem in this San Luis Valley (page 425). The only break you see is to the south, on the New Mexican border. Towards that gap the river turns, below Alamosa, and through steep-walled gorges hurries out of Colorado. Remote now from paved roads, though still reached by trails here and there, the runaway stream battles its frothy way through regions of jigsaw-puzzle topography, often so rough that only men on foot can climb through them.

From where your motor road again strikes the Rio Grande bank, below Taos, you pass a steady string of Pueblo Indian ranches and villages until you're far down about Albuquerque.

Somebody said a country is best judged by what its people get out of life. If that is true, this upper Rio Grande Valley is a good country. You have only to find a quiet corner, sit still, and watch the Indians at their field or village tasks to see with what pleasant mien they go leisurely about their simple duties, and in what wholesome comfort they live, surrounded by their families, friends, their fruits and flowers, their crops and flocks.

They stick to old beliefs. Bert Phillips, Taos artist, told me that on one painting trip his Indian model killed a deer. It was getting dark, and snowing, so the Indian hung the deer in a tree, planning to come back for it next day.

When he did, the deer had been eaten by lions and bobcats. Enraged, the Indian hunter mounted a stump and delivered an abusive harangue against the wild animal thieves. Immediately from the forest walked a buck much larger than the one the wild

animals had stolen. Stopping his harangue, the Indian shot this deer.

"Not in a thousand years," said Phillips, "could I have convinced my Indian friend that his abusive speech to the wild animals had not shamed them and forced them to send him another deer in place of the one they stole."

Along this river Indians live now, as for thousands of years, watering their bean and squash patches through crude dams and gravity ditches.

Maps drawn by Newman Bumstead and Ralph E. McAleer

IN WESTERN COLORADO RISES THE TURBULENT RIO GRANDE

Near its source many of John C. Frémont's party froze to death in 1848, seeking a pass over the Divide. Foaming through Wagon Wheel Gap and past pine-clad hills alive with trout and beaver, the river streaks across rich San Luis Valley, then battles its frothy way through rugged canyons into the jigsaw topography of northern New Mexico. The inset is a key to the page numbers of the accompanying maps which depict the course of the Rio Grande.

PETRIFIED BONES DOT THESE HILLS

Through all these gorges and vast gravel beds, what a happy hunting ground for the geologist! Here he can sketch the history of this valley from the Age of Amphibians through the Age of Reptiles, of Mammals, and down to Man.

Long ago seas rose and fell here, earth-crust broke and folded to form the Rocky Mountains, volcanoes erupted and lava flowed and ashes fell and added their plastic surgery to the world's face, and finally made a valley for the Rio Grande. Shot through these cosmic trash piles lie the rich fossil deposits from ages past.

One rare find was a huge turtle.

"Most startling of all," says Dr. Stuart A. Northrop, Professor of Geology at the University of New Mexico, "is the weird mummy of an Aden ground sloth, complete with tendons, claws, and patches of skin and yellow hair, found in a cave near Las Cruces —a strange animal that died not more than a few centuries ago."

Bones of bewildering groups of clumsy reptiles and giant animals are preserved in these hills and gravel beds, like one vast petrified Madame Tussaud waxworks. This frozen menagerie belongs to different ages; here are mastodons, dinosaurs, and many beasts from rhinos and giraffes to ancestral cats and apes; and from the muddy days, salamanders ten feet long.

IF DINOSAURS CAME TO LIFE!

In his wisdom, the Creator put men along this river only after such monsters had died. Imagine the panic now if, in some fantastic resurrection, a herd of such creatures might suddenly appear in the streets of Albuquerque just as children were quitting a movie matinee! Tipping over streetcars, smashing foodstore windows to gobble whole crates of cabbages and coconuts, a few such beasts could dominate the city.

Photograph by Luis Marden

HIGH UP ON THE CONTINENTAL DIVIDE ICE-COLD MOUNTAIN BROOKS FORM THE SOURCE OF THE RIO GRANDE

Here the historic stream starts as clear, sparkling snow water; then, for 1,800 troubled, turbulent miles it tumbles through rocky canyons, sprawls across sandy flats, falls over dams, and is robbed by irrigation ditches till at last it slips wearily into the Gulf of Mexico, a sluggish, much depleted river.

Photograph by Luis Marden

BUSY BEAVERS DAMMED THE INFANT RIVER TO MAKE A POND NEAR BRISTOL VIEW

At the right, beyond the jutting rock, rises a beaver house. Aspens and coniferous trees, which provide food and building materials for the little animals, line the slopes. From the dam a forest ranger casts for trout.

Photograph by Rudy Arnold

U. S. COAST GUARD PLANES, BASING AT EL PASO, HELP PATROL THE FRONTIER AND SUPPRESS SMUGGLING

Pursuing outlaw aircraft, these armed Government planes can fly alongside, cover the smuggler pilot, and force him to come down at the nearest landing place. They also make observation patrols, spot suspicious-looking movements of men or vehicles along the river banks, and warn by radio the nearest border land patrol station (p. 453).

Photograph courtesy the Denver Post

MAIN STREET IN CREEDE'S ONCE BOOMING BOISTEROUS SILVER CAMP AS IT WAS NEARLY 50 YEARS AGO

Today, its rich mines exhausted, the dwindling Colorado community is but a ghost town; most of the buildings seen here have disappeared (page 416).

RIVER QUENCHES NEW MEXICO'S THIRST

Through arid lands, fruitful only by irrigation, the north-south Rio Grande trend has formed a travel route since aboriginal days. Here its course is broken by numerous reservoirs.

Only U. S. soldiers with tanks and field guns could stand them off!

Though the middle Rio Grande has no great tributaries, one of importance, the Rio Chama, flows into it north of Santa Fe. Near Chama's mouth lie the ruins of one of America's earliest churches.

Examining old adobe foundations here, we noticed that the bricks were shot through with bits of pottery, fragments already old when they found their way into the mud as Juan de Oñate's men built this first of all New Mexican white settlements in 1598.

Nearing Albuquerque, where man has wrestled with this unruly stream for centuries, its valley broadens to form rich farms.

Fly about Albuquerque today and you see hundreds of miles of new levees, drainage ditches, and canals, wherein giant dredges splash the mud like bygone dinosaurs at play.

HERE FLOURISHED A FEUDAL SYSTEM

The Rio Grande, like the Nile in Egypt, forms a valley down through this State along which man has grown crops for centuries. Harvey Fergusson's book, *Rio Grande,* makes a good pattern for Emil Ludwig's *Nile,* published several years later. Both are tales of civilization along ancient rivers.

Down this valley, in the shade of cottonwoods, Spanish settlers built their adobe houses, with wide verandas, corrals, patios, and vineyards.

For generations this medieval life prevailed, with all its feudal aspects, Castilian courtesy, rigid social rites—and arrogance.

At such Rio Grande hamlets as Chimayo, Penasco, and Chamisal, you may still find among obscure people something of the perfect politeness to wandering strangers which must have marked the feudal barons for whom their ancestors toiled as house servants and herdsmen. Here are old looms, too, and skill with crude tools, and outdoor ovens, and ways of handling horses which hint at Spanish origin.

Today the names of these first families survive; but their ancestral homes are sand-blown piles of adobes scattered with broken clay pots and tiles.

Where their clumsy oxcarts squeaked over sandy trails, the shiny motorcars of visitors whiz now over smooth pavements. High above where Indian runners carried messages on foot now streak the silvery transcontinental planes.

Photograph by Luis Marden

MOUNTAINOUS SAND DUNES RISE LIKE SAHARA WASTES IN COLORADO'S HIGH SAN LUIS VALLEY

Winds, blowing for millions of years from one direction, have moved miles of sand across this enormous, high, hemmed-in area and piled it here in waves of ever-shifting hills. At the dunes' eastern edge, not seen here, trees are being engulfed (page 418).

Photograph by Luis Marden

"IT'S MY JOB TO LOCK UP THE UNITED STATES EVERY NIGHT AND HANG ON TO THE KEY!"

This barricade of iron and barbed wire, topped by a red light, swings shut in the middle of the International Railway Bridge at Laredo, Texas. Promptly at midnight, an American customs guard locks it, and no trains may pass till next morning. Nuevo Laredo, a busy Mexican city, stands at the bridge's other end (Plates I, XVI, and pages 416, 447).

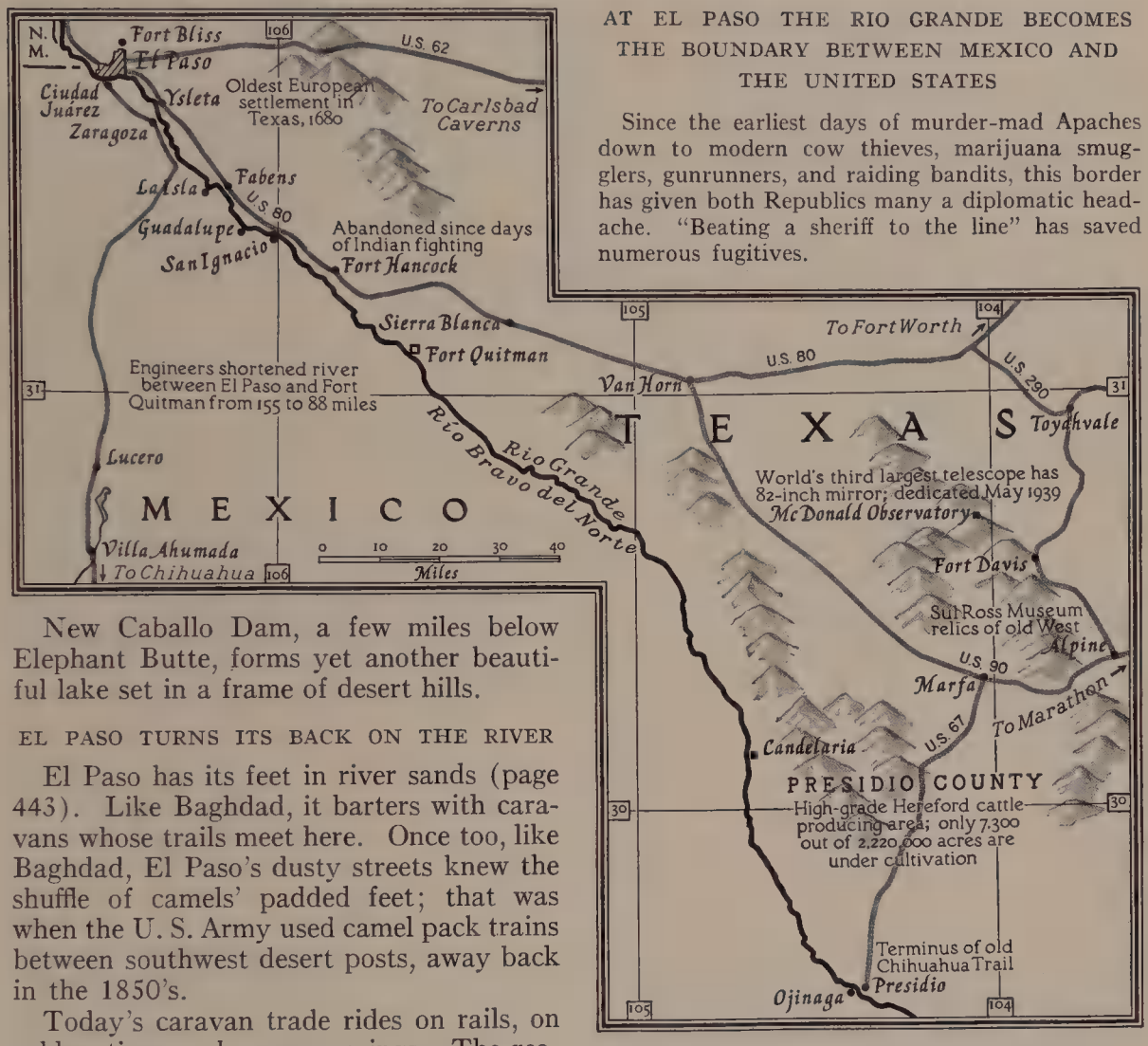
Grocers' delivery trucks carry factory-made bread, cold-storage meat, and chain-store vegetables to modern farm bungalows where the great ranch houses once stood, when Navajo slaves baked their elegant master's loaves, killed his meat, and grew his beans and onions.

PRODIGIOUS WORKS OF MAN

Follow U. S. Highway 85 south along the river, and in spring and fall you see enormous flocks of duck and geese, feeding and flapping and quacking and honking about in game refuges near Lajoya and Socorro.

It is the nature of this wild river, cowboys say, to "run with its shirttail out." Yet slowly, year by year, more of man's hydraulic feats appear, to cramp its liberty.

Elephant Butte Dam, near Hot Springs, forms a 45-mile lake (Plate XIV). Today city men flock here to cast for bass about the lake's brushy shores. At Hot Springs, health resort, beside the lake, stands the magnificent new Carrie Tingley Hospital for crippled children. Patterned after the Warm Springs, Georgia, institution, it employs every curative machine and appliance that money can buy—everything from iron lungs and indoor mineral pools to a factory where individual braces are made.



AT EL PASO THE RIO GRANDE BECOMES THE BOUNDARY BETWEEN MEXICO AND THE UNITED STATES

Since the earliest days of murder-mad Apaches down to modern cow thieves, marijuana smugglers, gunrunners, and raiding bandits, this border has given both Republics many a diplomatic headache. "Beating a sheriff to the line" has saved numerous fugitives.

New Caballo Dam, a few miles below Elephant Butte, forms yet another beautiful lake set in a frame of desert hills.

EL PASO TURNS ITS BACK ON THE RIVER

El Paso has its feet in river sands (page 443). Like Baghdad, it barters with caravans whose trails meet here. Once too, like Baghdad, El Paso's dusty streets knew the shuffle of camels' padded feet; that was when the U. S. Army used camel pack trains between southwest desert posts, away back in the 1850's.

Today's caravan trade rides on rails, on rubber tires, and some on wings. The reason so much trade converges at El Paso is that here the Rio Grande, cutting through the lower tail end of the Rocky Mountains in a prank of geography, forms historic "Paso del Norte," or Pass of the North, lowest of all transcontinental routes, and usually free of snow.

First seen by whites in 1536, when Cabeza de Vaca and his ragged band wandered through here after their Gulf of Mexico shipwreck, this pass in time became the Main Street of the Southwest.

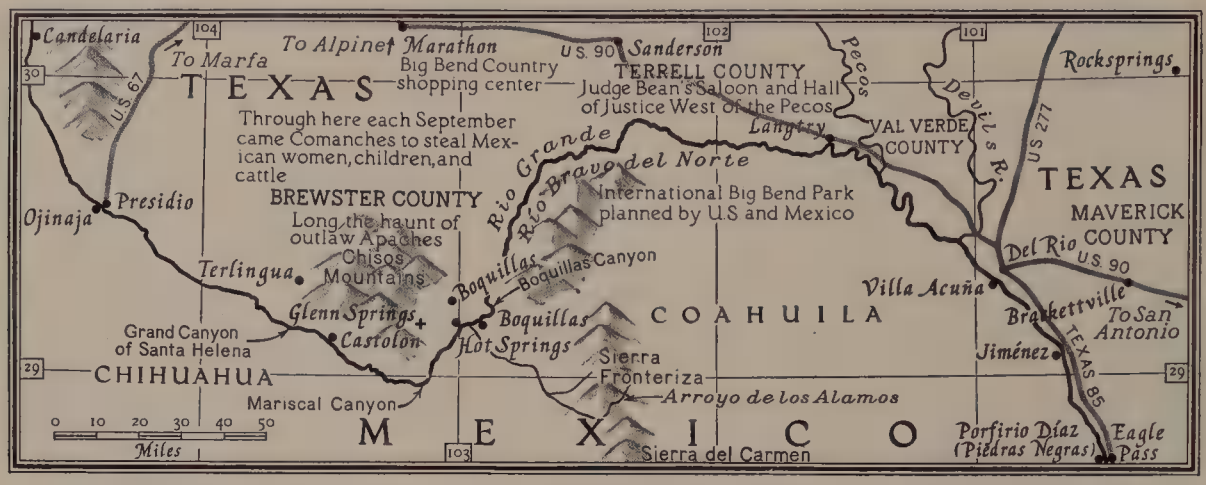
For nearly 400 years, the ford in the shallow river here has seen the singing legions pass—every kind of pioneer, from Spanish general and Mexican field worker to American gold seekers, beaver hunters, Indian fighters, cow-thief avengers—and overland stage drivers.

Four-mule stages, from St. Louis to San Francisco, first to cross the western deserts, began running through El Paso and fording the river near here in 1858. Today's bus and motor lines to California parallel closely this early road. Through here marched the Doniphan Expedition, recruited in Missouri to help Winfield Scott and Zachary Taylor win the War with Mexico.

At El Paso the international boundary crawls out of the muddy Rio Grande and runs west over plain and hill to the Pacific; it is marked with stone monuments, set so you can always see from one stone to another.

From high up on Mount Franklin's scenic drive, you look down on El Paso—and Ciudad Juárez, across the river in Mexico—as Nebuchadnezzar looked down from his palace roof upon the beauties of Babylon (page 448).

Through thin, clear air you see the quarters and parade ground of Fort Bliss, Uncle Sam's largest cavalry post; down the valley, smoke floats over busy smelters and oil refineries. Glistening temples to Mammon rise in the heart of the city, flanked by a grim courthouse on whose high top floor is set the city jail; through barred windows



IN THE BIG BEND COUNTRY, RIO GRANDE HAS CARVED DEEP GORGES THROUGH MOUNTAIN RANGES

prisoners enjoy a magnificent valley panorama, and in the cool of the evening you may hear them singing.

Juárez, with its liquor stores, bull ring, race track, cafes, dance halls, night clubs, curio and perfumery shops, and with its noisy market where heaps of vegetables, fruits, and gorgeous cut flowers contrast with fresh meat black with flies, looks, smells, and sounds like any other border town. Yet, to the river, both El Paso and Juárez turn their backs. No boats are here, no wharves, no bustling, colorful water front, as in Memphis or Shanghai.

STREAMLINING THE CROOKED RIVER

From El Paso down to the sea, by treaty of 1848, the middle of the Rio Grande's main channel was fixed as the boundary between the United States and Mexico.

But this reckless river often shifted its channel; people settled near it found themselves first living in Mexico, then in the United States, and vice versa.

To keep the peace in disputed areas, and rectify the border, an International Boundary Commission was set up 1889. Another treaty, in 1933, provided for taking kinks out of the river, and for new levees.

Ysleta, twelve miles below El Paso's smoky smelters, is an old Spanish town in whose mission padres began singing *Venite Laudamus Domino* in 1682. One farm here has been in continuous cultivation for the past 257 years.

Graceful cottonwoods, busy cotton gins, sumptuous ranch houses and California-type bungalows, with here and there a swimming pool or a tennis court, line U. S. Highway 80 as you drive downstream to Fabens.

Below Fort Hancock, abandoned after Indians were subdued, the highway quits the river to join No. 90 at Van Horn and does not return to the Rio Grande until you reach Del Rio, 600 river miles below.

Few people realize how isolated this part of the United States really is. Look at a Texas road map. On it you see that in these 600 river miles no main road at all touches the Rio Grande, except one running south from Marfa to Presidio.

Here at Presidio, and in the vast, wild Big Bend country below it, may be indeed our last frontier. In 75 years, Presidio, long ago a Spanish military post, has changed but little. It is the old terminus of historic Chihuahua Trail.

Toward Presidio once advanced the much-discussed Kansas City, Mexico and Orient Railway. Though never completed, by this bold plan rails were to have linked the Missouri River with Mexico's Pacific coast at Topolobampo, where Kansas City men years ago laid out a town site and built a few miles of track.

Worth visiting near Ojinaga, across the river from Presidio, is a mountain chapel whereby hangs an odd tale. Behind it is a cave wherein, Indians said, the Evil Spirit dwelt. Aided by a priest, Indians walled up the cave and thus put the Devil in jail for life. Each year, on May 3, in the tiny chapel, a ceremony commemorates this conquest of the Devil!

Going back north, you rejoin Route No. 90 at Marfa and go east through Mongolian-like valleys where wild antelope frolic, and on to Alpine, at whose Sul Ross Museum is shown a fascinating lot of relics from old days, including fragments of emigrant wagons burned by Indians, old Spanish

Photograph by Luis Marden

TEXAS RANGERS AND BORDER PATROL MEN LUNCH WITH MEMBERS OF THE GEOGRAPHIC'S RIO GRANDE SURVEY

For nearly 100 years these hard-riding Rangers have been the dread avengers of evil in Texas. Though a clever outlaw may "skip the rope"—dodge justice for a time—sooner or later, cornered by the Rangers, he must "pay the fiddler."

Photograph by B. Anthony Stewart

CORN CAKES, SPRINKLED WITH RED SUGAR, BAKED FOR A MEXICAN WEDDING

In Zapata County, scene of this cow ranch marriage, Mexicans control elections. Texas has some 687,000 residents of Mexican origin, says the 1930 census. All Rio Grande towns, from Taos and Santa Fe down to El Paso, Del Rio, Laredo, etc., are bilingual and Mexican in character.

weapons, and time-faded documents recording the deeds and adventures of pioneers.

From Alpine, Route 90, with mountains on every horizon, leads you east to Marathon, entrance to that strange, isolated region of America—the Big Bend of Texas.

BIG BEND DISTRICT THINLY PEOPLED

Swerving far south to cut a vast piece-of-pie-shaped area of burnt-up desert, overgrazed valleys, and lofty, wooded mountains out of Mexico, the Rio Grande here makes its spectacular "Big Bend" (map, p. 428).

In this caprice of physical geography, the river has scoured its dark, mysterious way through three long rutlike canyons, Santa Helena, Boquillas, and Mariscal.

You might loose half a dozen eastern States in this waste of sun and silence; yet people are few and far between. The tiny quicksilver mining camp at Terlingua, with flat-roofed Arablike houses and no trees, is the nearest approach to a town.

On the Mexican side, towns are even more scarce; even the Mexican customs agent at Boquillas village, having no direct communication with his own country, comes across to Hot Springs to get his official mail!

Consider Glenn Springs. At the time of the "Glenn Springs Raid," that name stood in scareheads on front pages. Yet now it has just three houses! One of these, in ruins, sheltered a few American soldiers that fatal day in 1916 when bandits swooped down on it, set fire to it Indian fashion by throwing torches on its roof, and then shot the troopers as they ran out.

How scattered Big Bend cowboys mobilized and revenged that raid is among the wild and woolly classics of west Texas. The sandy ground hereabouts is still strewn with empty cartridges.

Nobody here has a "near neighbor"; ranch houses are miles apart. At many, daily life is truly primitive. Much of the talk is about lions, water, and cow thieves. Marathon, far to the north, is to these isolated families the center of the world.

"I moved here from Arkansas in 1909," said Sam Neale, who runs a few cattle on the west slope of the Chisos. "Since then mountain lions have killed about 600 of my horses and colts."

Said a woman who rides herd with the men: "Last winter the lions killed all five of my saddle horses." To me they showed a two-year-old filly, badly bitten and scratched, crippled for life by lions.

"But you trap and shoot all the time—" I began.

"Sure," they argued, "but the lions have begun coming across the river from Mexico. Meat is scarce over there; hunger drives them up here." Later, on the river bank, I saw fresh tracks where three had just crossed.

Towering high over the rest of Texas, filled with a strangely assorted plant, bird, and animal life, this Big Bend is often referred to as a "biological island."

Every plant in the Big Bend "either sticks, stings, or stinks," sheep men say. One plant is named "It Blinds the Goat," because fine spines fly off and into the eyes of any animal grazing too near.

Sheep and goats eat more different plants than cattle do. This makes sheepherders better botanists than the cowboys are; they have a name for every plant, weed, shrub, or flower. But nobody ever sings ballads about sheepherders as they do about cowboys!

One night when I had a tummy ache, they made me tea from the vinegary St. Nicholas plant, and cured me. Lying on the bare ground, you may see what looks like an old leather button lost from somebody's overcoat. That object is in fact a young peyote plant. Mexicans use it as a vermifuge. It has a bad name in the United States because Indians take it as a narcotic. Shoshones and others, living hundreds of miles from the Texas border, make long auto trips down here to buy peyote. They use it as a stimulant in tribal ceremonies.

"That peyote plant can speak," a Mexican told me. "To good men in trouble, it gives advice, on request. It can disappear, too, at will."

Fording the Rio Grande on muleback at Boquillas, we rode south some 40 miles into Mexico, and up into the Fronteriza Mountains. Late one night we came to a goat rancher's home in lonely Alamos Canyon; here a goat man is called a "pastor." This one was much excited; lions had just killed 18 of his goats. In revenge, he dogged the lions up a wooded canyon and shot three. Next morning for breakfast, the "pastor" cooked the youngest of the three lions, and gave us some of the broiled ribs. The cooked lion meat looked and smelled like beef—but didn't taste like it.

On the foot of an old iron bed in the pastor's cabin a parrot roosted. At dawn he flew out, and off into the mountains.

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Dufaycolor by Luis Marden

CAN HE MAKE NEW YORK—FROM TEXAS—BEFORE THAT THUMB WEARS OUT?

With his striped serape, big Don Quixote spurs, and precious guitar, he stands, a symbol for hitchhikers, at the American end of Laredo's International Bridge.

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Kodachrome by Luis Marden

FOWL PLAY! COME ON, ROOSTERS! TAILS YOU LOSE—AND YOUR OTHER FEATHERS, TOO!

Look at the shadows on the ground. They show how, in this cockfight, one rollicking rooster jumps over the other, to smack him from on high. What looks like false whiskers on the girl in a white shirt is a bandanna, worn for protection against desert dust.

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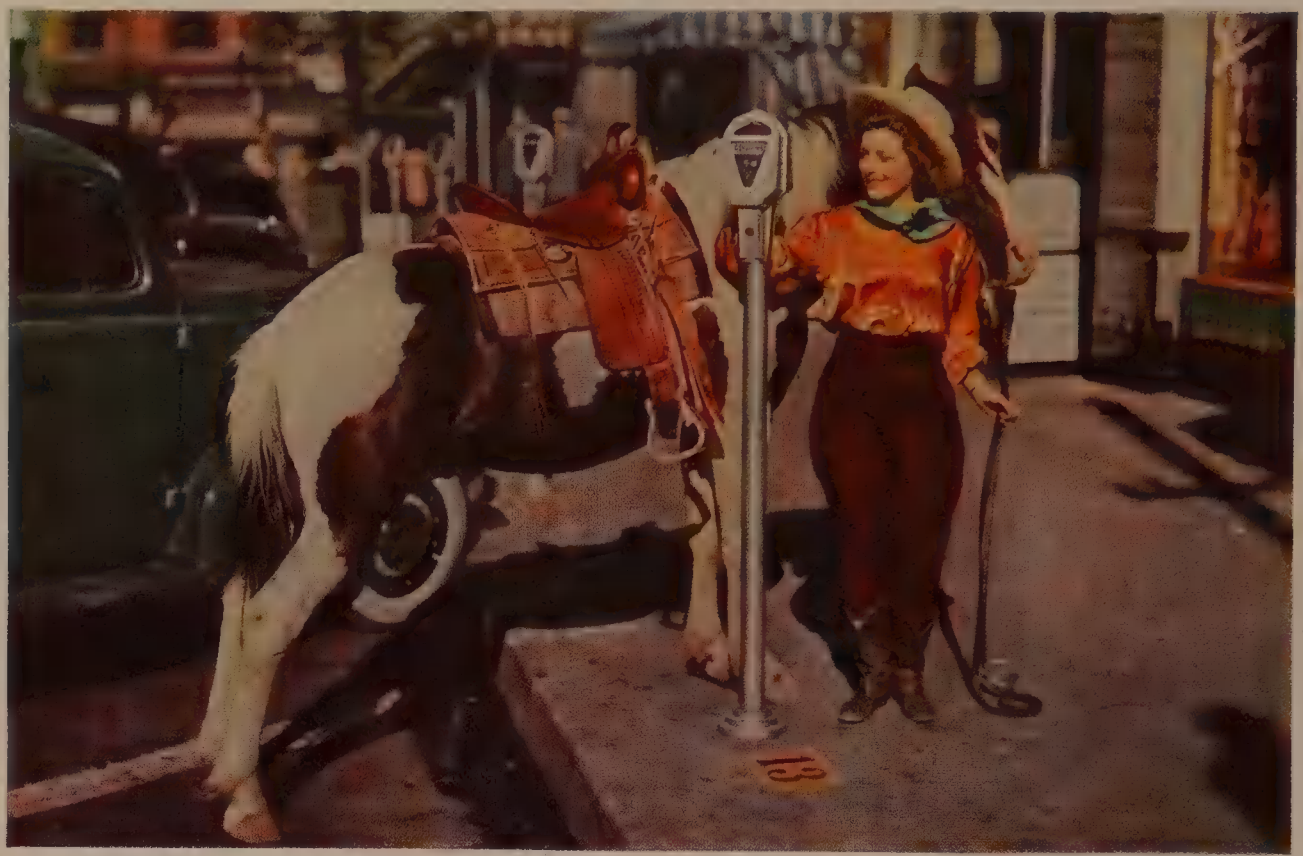
Dufaycolor by Luis Marden

HERE THE PECOS, FLOWING ACROSS WEST TEXAS, EMPTIES INTO THE RIO GRANDE

Cliffs form the United States frontier; lowlands at right are in Mexico. The tree-grown ridge at the cliff's base marks the pioneer roadbed of the Southern Pacific Lines, now relocated on the mesa above. In the Pecos's mouth stands a ruined bridge pier over which once rumbled California trains.



Dufaycolor by Luis Marden

DROP A NICKEL IN AN EL PASO PARKING METER AND HITCH YOUR PONY

This half-Mexican border city is still horse-conscious; many residents are cow-ranch folk. Near-by Fort Bliss, Uncle Sam's chief cavalry post, uses many horses and mules, despite motorized Army transport.

© National Geographic Society

Dufaycolor by B. Anthony Stewart

INSECT PESTS MAY RIDE IN ON CUT FLOWERS IMPORTED BY AIR EXPRESS

These uniformed inspectors are plant quarantine agents of the United States Department of Agriculture. With microscopes they scrutinize every cargo of gardenias and other fresh flowers flown across the Rio Grande to American soil.

Dufaycolor by Luis Marden

BIG AS A BRAIDED RUG, THIS IS ACTUALLY A TEXAS STRAW HAT

She'd blow clear away in a border dust storm! Though the making of huge straw sombreros is a lower Rio Grande industry, such giant wagon-wheel sunshades are braided only as novelties.

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Dufaycolor by Luis Marden

IN A LONELY BIG BEND COUNTRY STORE THE CUSTOMER GRINDS HER OWN COFFEE

Far from railroads or main highways, a combined post office and general store forms the whole "town" of Castolon. It is a survival of pioneer days, carrying everything from horse collars and lanterns to cheese, crackers, and bear traps.

© National Geographic Society

Kodachrome by Luis Marden

THIS LOOKS EASY HERE, OR ON A MOVIE SCREEN, BUT TRY IT YOURSELF IN THE THORNY TEXAS BRUSH!

Even leather pants and jackets are not always proof against sharp snags and long thorns. Sometimes even the horse's breast is shielded by a canvas apron. Swinging his riata for a throw, this yelling buckaroo runs a wild steer through mesquite hills below Laredo.

© National Geographic Society

Kodachrome by Luis Marden

TEXAS RANGERS HELP THE CUSTOMS BORDER PATROL ROUND UP A BUNCH OF "WET" CATTLE NEAR LAREDO

A "wet" animal is one which has been smuggled across the river from Mexico into Texas. Such stock may either have been stolen, or merely driven across without the formalities of customs entry or fever tick inspection. A favorite trick of smugglers is to drive a herd across at night, then mix it with cattle already legally at home in Texas.

© National Geographic Society

Kodachrome by Luis Marden

GOING FISHING, FATHER PELICAN TAKES OFF OVER THE STORMY GULF OF MEXICO

Veteran of many a hard hop he must be, judging from his ragged wings and frazzled tail. Till recently, such high-speed color photography was impossible. This exposure was made at stop F 1.5 and 1/1000th of a second in a miniature camera.

"He first showed up here about 15 years ago," said the goat man. "Every night, towards sundown, he flies in to roost on my bed, and then flies away again every morning. We don't know where he goes."

From the goat camp we climbed for weary hours up steep, winding trails, coming finally to a high, uninhabited land of virgin forests and valleys deep in grass, marked only by deer paths. On higher ridges stood black trunks of pines fired by lightning; nowhere was any sign of man's work with the ax. About rotting logs, bear had dug for grubs. Here, truly, is yet a "lost world"; here, from the west rim of Carmen's cliffs, you can look out over infinite blue Mexican emptiness and see the Rio Grande curving under the Chisos, leagues to the northwest.

Laboriously our tired mules stumbled back down the long trail; cinches broke and saddles slipped up on the animals' necks, and we rolled off to walk and lead down some almost perpendicular canyon-sides strewn with loose rocks.

Again, at the pastor's that night, the talk turned to lions. And again, as often in the Southwest, Mexicans reiterated that the lion, crouching in brush, waves his tail aloft, thus arouses the curiosity of a colt, a calf, or burro, lures his victim nearer, and then jumps on him. Slipping quietly outside during this lion symposium, Marden, the Boston tenderfoot photographer, suddenly growled with such leonine realism that sleeping dogs sprang up barking, and, for one ridiculous moment, even the veteran Mexican mountaineers glanced anxiously out into the black night.

Back in the Chisos, days later, we camped in the shadows of the peaks.

"Rocks here represent many periods of geologic time," said Dr. Ross Maxwell, geologist of the U. S. National Park Service. "Some are among the world's oldest."

More than once ocean waves tossed over this country. Water stood in depressions, after the ocean receded, and around these lakes and swamps dense vegetation finally grew up.

Dinosaurs enjoyed this environment of marshes fringed with plant life. When one ventured too far into the quagmire and got stuck and died, or was killed in a fight, mud soon covered his body, and his teeth and bones were petrified.

You see such bones now, as well as elephant teeth, fossil oysters thirty inches in diameter, petrified snails, trees, a clam four feet across, and petrified remains of fish, turtles, and sharks—all stored in a small pine shed left by road workers in the basin of Chisos Mountains. On it a wag has placed this label: "A Museum Is a Collection of Labels, Illustrated by Specimens."

These and other wonders of Nature now stimulate the imagination of two Republics. From this Big Bend, and adjacent Mexico's equally sublime landscape, it is planned to form a vast international park, to be made accessible by motor highways from north and south of the Rio Grande.

Far downstream near Langtry, where the steep-walled Pecos pours its alkaline west Texas waters into the Rio Grande (Plate III), you see now all that's left of notorious Judge Roy Bean's once-famous "Saloon and Hall of Justice West of the Pecos" (page 446). With one old lawbook, no legal training, and a six-shooter, Bean meted out frontier justice and supplied plots for a generation of Wild West story writers.

Best known of all Bean legends is this: Finding a dead Chinese, Bean searched him and took off a six-gun and $40. "I'll fine him $40 for carrying that gun and confiscate the weapon," announced the judge! Another yarn says that Bean once chained a lawyer to a tree when the lawyer had threatened to appeal from a Bean decision.

We climbed down into the bottom of Pecos Canyon, followed it to where its greenish waters mix with the muddy Rio Grande, and hunted a cave with Indian paintings. Here are crude figures of men and animals, a group of palm trees, and a sketch suggesting the local course of the Rio Grande, with the mouths of the Pecos and Devils tributaries.

DEL RIO ECHOES TO THE BLEAT OF GOATS AND SHEEP

When we tried to photograph a herd of goats browsing near Del Rio, shepherd dogs on guard drove us back. Brushy landscape here is rich with smells of goats and sheep, and noisy with their bleatings at dawn and dusk.

Only wild animals and a few nomad Indians ruled here in 1590, when Gaspar de Sosa led his band of Spanish colonists across the river on their way to settle in New Mexico. Women and children rode mules, and oxen hauled carts heavy with plows, furniture, and tools for the new homes these pioneers planned to make in the upper Rio

VAST SOLITUDES AND THEN LAREDO!

Grande wilderness. Had two hundred migrating Europeans crossed any river in our eastern States 350 years ago, every schoolboy would know about it. Yet only lovers of Southwest history ever heard of De Sosa!

Armadillos worried the first Del Rio family I talked with. "They prowl at night and root up our flower beds," was the complaint.

Just above this lively town of parks, playgrounds, good duck shooting, and scenic lakes, the Devils River foams over rocky Texas rapids where we saw women in hip boots casting for fish, and tumbles into the Rio Grande. Here our barometer showed less than 1,000 feet above sea level, a drop of more than two miles from the Rio Grande's Colorado source.

By a fine bridge you drive across to the neighboring Mexican town of Villa Acuña, noted for its dinners of quail, duck, and venison.

"After running cattle 15 years down in Coahuila," said a Del Rio rancher, "I have quit there for good. So have many other families. We couldn't stay in Mexico, conveniently, because of the expropriation policy and the agrarian reform laws." In fact, all down the river, from Juárez to the sea, we heard the same story and saw many herds of American-owned cattle being brought to the American side of the Rio Grande.

"Bump Gates" on a rough back-country road we took from Del Rio partway down to Eagle Pass were new to me; you don't have to get out to open such a gate (page 441). You just drive your car against it, it opens, you ride through, and it shuts itself. On this ride we traversed a typical pioneer cow country, with a ranch 50 miles across. It grew dark, and coyotes yelled from lonely hills.

Said a lady of Eagle Pass: "I didn't know I was the tree-climbing variety of woman till yesterday, when I was treed by a wounded javelina. My husband and I were deer hunting; we shot at some javelinas, and one came right for me. People say javelinas never chase you; nevertheless, there I was up a tree, and when I got my breath and looked down, there was friend husband on another limb!"

EAGLE PASS A BUSY PLACE

Since Civil War days Eagle Pass, with its twin Mexican city of Porfirio Díaz (Piedras Negras), has been a busy spot on the border. Here, by a bridge, the Southern Pacific Railway ties up with the Mexican International. On the Mexican side is a railroad division point, with shops, office building, and homes for employees. Piedras Negras boomed furiously years ago, when five or six times as many Americans lived in Mexico as remain there now.

When Eagle Pass's pleasure-loving people are not dining and dancing in cabarets across the river, or off on a hunting trip, it occupies itself with wool, hides, cattle, coal mines, brick kilns, and lumber.

Quail, by the tens of thousands—I saw 80,000 in one warehouse—pipe and flutter in coops, awaiting shipment from Piedras Negras. They come to restock game preserves and estates anywhere from Maryland to California. "To catch them," explained a quail worker, "we put out a wing net and drive them into it. They never really get tame." Even those he had had cooped up for weeks fluttered with fright when we walked near their coops.

Below Eagle Pass your motor road down this valley again swerves far inland, passing some of the largest remaining cattle ranches

"SIT STILL! YOU NEEDN'T CLIMB OUT—THIS TEXAS BUMP GATE SHUTS ITSELF!"

Cowboys invented this labor saver. Amidships the heavy gate turns on the upright pole. Bumped open by the car, the ropes twist; untwisting, they close the gate on a sheep ranch near Del Rio.

Photographs by Luis Marden

"WHEN MY MULE FEELS A SLOW LEAK COMING, HE BALKS—HE WON'T PULL ON A FLAT TIRE"

Roman chariots may have been gilded and shaped with more grace, but they never knew the ease of pneumatic tires. In Laredo, Texas, now no vehicle with old-fashioned iron tires is allowed.

Photograph by Luis Marden

THIS DIZZY-LOOKING, SPINDLE-LEGGED BRIDGE SPANS THE PECOS RIVER ABOVE ITS CONFLUENCE WITH THE RIO GRANDE

The Pecos, rising in northeast New Mexico, flows southeast across west Texas, to form one of the Rio Grande's chief tributaries. Here Southern Pacific trains cross the rock-walled canyon on their long runs between New Orleans and California (Plate III and page 439).

Photograph from Louis V. Olson

MESILLA DAM, IN THE RIO GRANDE 41 RIVER MILES ABOVE EL PASO, DIVERTS WATER FOR IRRIGATION

In the distance are the Franklin Mountains, rising above El Paso, Texas, the largest city on the United States-Mexico border. For use of farms on the Mexican side, water is taken off near where the river becomes the international boundary (map, page 427).

Photograph by W. D. Smithers

RANCHERS, TRADERS, BANDITS AND SMUGGLERS FREELY FORD THE STREAM IN THE THINLY PEOPLED BIG BEND COUNTRY OF TEXAS

For hundreds of miles here no large settlements exist. Customs and immigration patrols are few and far between. Food is scarce in this empty wilderness; so, by tacit consent, scattered local residents come and go across the border, with little official interference (page 430).

Photograph by Luis Marden

USING THIS MULTIPLE SHEARING MACHINE, 12 NIMBLE TEXANS WILL CLIP 1,200 TO 1,500 SHEEP A DAY

Moving his truck from ranch to ranch, Miguel Cardenas, of Del Rio, charges 8 cents each for clipping sheep and 5 cents for goats. On the truck, the 12 little shearing motors work independently. Rambouillet sheep predominate in Val Verde County, where this crew shears a flock on the Russ M. Hamilton Ranch.

TODAY PEGASUS MAY FLY ON WHEELS TO SCENES OF BORDER TROUBLES

Here a patrol of the U. S. Bureau of Customs hauls its mounts to distant strategic points for law-enforcement work. That tall, Nebraska-hatted rider is Texas Ranger Joe Bridge. Cowmen say his flat, wide-brimmed black hat is the last of its kind now in daily use in the whole once woolly West! Observe how calm and satisfied the saddled horses are. Why not? For ages they leaned wearily into hard collars, pulling the heavy carts in which they now ride so luxuriously.

Photographs by Luis Marden

DECADES AGO "JUDGE" ROY BEAN'S "COURTHOUSE," NOW LEFT TO RATS AND OWLS, MADE FRONT PAGE NEWS FROM COAST TO COAST

In one crowded room Bean, a singular character, combined his court, saloon, and country store. Racy yarns of Bean's eccentricities, and of how he passed quaint judgment despite his lack of books or legal training, live in the classic annals of west Texas. It is told that Bean once chained to a tree a lawyer who had sought an appeal from a Bean decision (page 439).

in the West. This is a wild, thinly peopled area; you may ride for a score of miles and not see a house.

Squads of crows patrol the paved highways, feeding on rabbits, skunks, and snakes killed by speeding cars. Sometimes the sly old coyote himself, blinded at night by headlights, gets hit and pressed into two dimensions. Every successive car pounds him still flatter, till he spreads out like a bedside foot rug!

THE NEW HIGHWAY TO MEXICO CITY

"We're knee-deep in oil, onions, and tourists," they said in Laredo. "In 1938 some 22,500 cars crossed here, taking the new highway to Mexico City (Plate XVI).

"These visitors swarm south with travelers' checks and come back loaded with big hats, serapes, and broken pottery. Some step on the gas and make the 770-mile run between here and the Mexican capital in twenty-four hours."

Thousands of Mexicans lined the hills outside of Laredo one Sunday morning as we watched a Hollywood troupe filming *The Texans*. An immigrant train, drawn up in the familiar old covered-wagon circle for defense, was to be attacked by a band of mounted "Indians"—Mexican boys whose faces had been daubed with war paint by a movie make-up artist.

Photograph by Luis Marden

LATEST TEXAS HORSE FASHIONS GIVE DOBBIN DUST GOGGLES FOR HAPPY MOTORING

Wind, as well as dust, insects, and flying pebbles that might hit the horse's eyes, is deflected by these glasses. They do not help vision, but they do afford eye safety and comfort when a mount rides at high speed in a two-wheeled crate hooked behind a cowboy's flivver (page 446).

For realistic effect, the director wanted the battlefield to be strewn with dead men and dead horses. So they brought along dummies of men and horses stuffed with sawdust. When movie roustabouts began walking down a plank from a sidetracked express car, each carrying a "dead man" or a "dead horse" on his back, the Mexican spectators burst into shouts of derision. When the leading lady, taking time out for lunch, sat down on a "dead horse" to eat her sandwich and hard-boiled egg, the Mexican women onlookers grew almost hysterical with mirth.

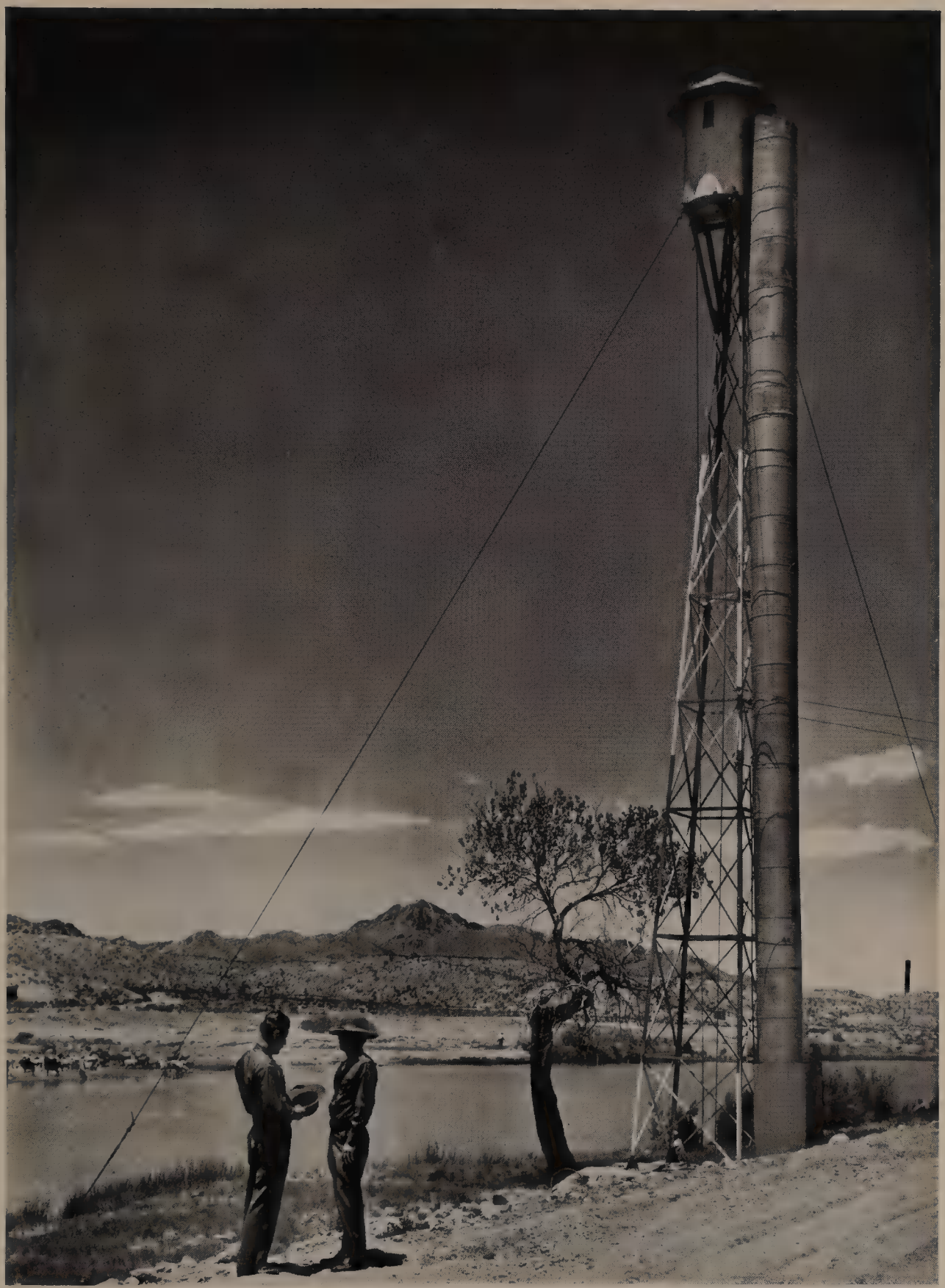
"ALL DAY A SUSPICIOUS CHARACTER HAS HUNG AROUND THE MEXICAN END OF THAT BRIDGE—NOW HE'S TRYING TO SLIP ACROSS!"

From this El Paso observation tower immigration inspectors keep close watch on the Rio Grande banks and bridges, on the lookout for smugglers and persons attempting illegal entry into the United States. Through the window is seen a part of the Mexican city of Juárez.

Photographs by Luis Marden

SOME ISOLATED RIO GRANDE MEXICANS STILL STRIKE FIRE WITII FLINT AND STEEL

At the Mexican river village of Ojinaga, Chihuahua, an Indian peon looped some tow about his left wrist and showed Photographer Marden how the modern Boy Scouts may try it. His steel is a bit of an old rasp.



Photograph by Luis Marden

BORDER PATROLS OF THE U. S. IMMIGRATION SERVICE TALK THINGS OVER AT A WATCH TOWER BELOW EL PASO

Cattle are seen drinking across the shallow, sluggish stream, on the Mexican side. American residents on one bank and Mexicans on the other mingle freely in friendly business intercourse, but official scrutiny of the boatless border river is tense, constant, and vigilant (page 448).

"WHEN WE GIVE POPEYE THE SPINACH, HE HARDLY KNOWS HIS OWN STRENGTH—FEEL THAT MUSCLE!"

From rich, irrigated Rio Grande Valley fields about Crystal City, Texas, trainloads of spinach are cut, iced and shipped each season. There, in honor of Popeye the Sailor, patron saint of spinach farmers, this ridiculous effigy was erected.

Photographs by Luis Marden

"HORSE THIEVES FROM ACROSS THE RIVER SHOOT AT US NOW AND THEN—BUT WE'RE STILL HERE"

She's bona fide—one of the few still-surviving, honest-to-goodness cowgirls. She "rolls her own," can ride anything with hair on its back, and helps her husband manage a successful ranch near Glenn Springs, Texas (page 430).

Photograph by Luis Marden

CLOUDBURSTS WEST OF SANTA FE SUDDENLY FILL UP DRY ARROYOS WITH WHITE FLOODS RACING DOWN TO THE RIO GRANDE

The aerial camera caught the mud-whitened tributaries—merely dry washes except immediately after heavy rainfall—just as they began running full. Often the spearhead of such a sudden canyon flood forms a rushing wall of water from 5 to 10 feet high. Pushed ahead of it or tumbling along with it may come boulders, brush, fence posts, dead burros, or cattle—in fact, every loose object which lay in the bottom of the dry wash.

THIS MEXICAN SEAGOING FLIVVER IS USED FOR CROSSING ESTUARIES ABOUT THE LOWER RIO GRANDE

Rendered amphibious by its pontoons, it easily crosses inlets and lagoons where no bridges exist, and takes to the water when roads are impassable. A propeller, attached to the driving shaft, is used in water; the man with the lever throws the propeller "in gear." This picture was made south of Matamoros, at a channel connecting Laguna Madre with the Gulf.

Photographs by Luis Marden

NO MATTER HOW GRAY AND DEAD-LOOKING, THIS DESERT PLANT, PUT IN WATER, UNFOLDS FRESH AND GREEN

The author pulled the two, shown here, one hot day in the Big Bend Country. That night he laid one in a pan of water; the other, held in his left hand, remains as it was when plucked from among the hot, waterless rocks. Mexicans call it the *siempreviva*—"always living."

THE BORDER SHIFTS CONTINUALLY, WHERE THE WEARY RIVER COMES FINALLY TO THE SEA

Despite many dikes and barrages, the Rio Grande sometimes overflows its banks to flood the rich Texas Delta Country. When such floods change its course, the Boundary Commission faces the problem of readjusting the international line.

Vice President Garner, a familiar and beloved figure in Laredo, is also known by sight to many a Rio Grande fish.

"The yellow perch is my favorite," he says; "but the cats in that river grow as big as hogs. Some whoppers come out of the deeper holes."

And some tales are bigger even than the fish! They told me of one cowboy who tied a grabhook to his lasso, baited it with a goat leg, and hooked a catfish so big that even with his cow pony helping to pull he could drag the cat only to the river bank. Undismayed, he heated his branding iron and put his mark on the fish, and then let it go! "It's mine now," he said. "It's got my brand on it; nobody else can claim it."

Lower Rio Grande speech is salty. Of a loyal friend, men say: "He'll do to ride the river with." Winter underwear is "the long-handled kind," and the tight-kneed, ham-legged riding breeches of a visiting dude are "choke-bored pants." Lazy Mexicans say, "God gave us the nights to sleep in, and the days to rest in."

Anything that's been brought across the river unlawfully is "wet."

With Texas Rangers we went to watch the seizure of "wet" cattle (page 429). Thieves had driven these animals through the river and mixed them with cattle of Texas brands on our side of the stream. Rangers rode through the herds, picking out the "wets." River-bank shooting scrapes, between law officers and lawbreakers, are all in a day's work.

I talked with one cold-eyed border patrolman who had 27 notches in his gun. Since 1914, he said, about 2,300 men have been killed on the Texas side of the Rio Grande, counting both Americans and Mexicans. "Things were worst when rebels were raiding across the line," he explained. "They're much quieter now; the most serious trouble we have is with smuggling. Even that's funny, sometimes. One fat old gal at Laredo worked a slick trick. She filled cow guts with mescal, wrapped these around herself, under her petticoats, and walked boldly across the bridge into Texas. Spotting her odd bumps, our woman agent promptly unloaded her!"

Alcohol, in five-gallon tins, is often smuggled by air. A plane can haul a big load, and land it at some lonely spot far up in Texas or Oklahoma.

"At El Paso, they keep a Coast Guard plane; it often comes to our aid," said the patrolman. "Once we chased a suspected plane; we flew right alongside it and I covered its pilot with my rifle and pointed to a landing field ahead. He nodded, and landed. We followed him down, arrested him, and confiscated his plane and a huge lot of cane alcohol made away down in Sinaloa (page 422).

"Marijuana we always look for; lots of it comes over, in the form of the dried plant, smuggled in feed bags, in the rumble seat of cars, or hidden in baggage. Some is sold, rubbed fine to imitate smoking tobacco, and carried in second-hand tobacco tins." They showed us seized marijuana plants, which resemble hemp. How familiar all this is to many an old soldier who saw border service!

In American homes from Maine to Cali-

fornia, the Lower Rio Grande pictures shown with this article will awaken memories among thousands of men, grown a little gray now, who served here with the Regulars and the Volunteers during the border troubles of 1911–16, when news of raids, sniping, killings, and other "incidents" filled our daily papers.

THE WEARIEST RIVER RUNS FINALLY TO THE SEA

Today solitude and emptiness hang over long stretches of this lower river country. Most old-time army posts are deserted—in ruins. Terrell County, Texas, has less than one man per square mile. South from Catarina, on U. S. 83, we saw two houses in 43 miles. Zapata County has only 736 voters; more than 700 of these are of Mexican blood. When early-day U. S. Army men surveyed here, they saw frequent bands of wild horses, and deer in herds of two and three thousand.

Along a rough, brush-lined, lonely road from Zapata to Roma, we saw Mexican boys with dogs hunting bobcats. Some homes had "varmint-proof" hen houses. Old ways of life linger. About an open-air clay oven at a Mexican ranch, we saw women bakers wielding long-handled paddles (page 429).

"These cakes are for a wedding feast," explained a Mexican girl. "Making them is almost a lost art; nobody here knows how except these two old women."

Coming into Rio Grande City, you arrive at what used to be a river port. Flat-bottomed steamers puffed this far upstream before the river silted up and grew too shallow for navigation. In an old book I saw a picture made in 1865. It showed the plumed soldiers of Maximilian and Carlotta, with their toylike wheeled cannon, going aboard a steamer at Matamoros; from there they would drop downstream and board troopships waiting in the Gulf to take them back to Europe after the collapse of Mexico's French-fostered empire.

Another survival from old days is land grants, dating from the Spanish kings. I was in a Brownsville law office when one such tract was being sold by heirs of the original grantee, its first transfer since 1761! Such grants usually faced the river for one league, and extended far inland. As one generation after another inherited this land, each heir took his share in the form of a strip, always with river frontage so he might water his cattle. On record today is one such strip which is actually only thirty-six inches wide at the river and runs inland twelve miles! It is, however, not fenced off, but farmed by neighbors.

As I write this, Brownsville, on the Delta, is one of the busiest cities in the United States. Grapefruit made it so, as already told in this Magazine.*

Air travel helps. Here the giant skyliners of Pan American Airways halt to satisfy international border rules. Weary passengers alight to rest their ringing ears and stretch their cramped legs. Men in uniform rummage through baggage, turning out knickknacks bought in Buenos Aires, Lima, or Guatemala. With microscopes, plant quarantine men from our Department of Agriculture paw over orchids, gardenias, and other costly cut flowers shipped from Mexico City to Chicago or New York (Plate IV).

Then again the sky-riders hurry aloft, and away to the north—and probably half of them don't even know that the name of that muddy stream they just jumped was the Rio Grande!

Fifty-five miles downstream is the Gulf, river's end. Zachary Taylor landed here, in the War with Mexico, ninety years ago. Once U. S. Grant and Robert E. Lee saw service here. In these brushy, mud-strewn flats was also fought the last battle of the Civil War; a monument says so, but few stop to read it. On the Mexican side of the river's mouth once stood a town named Bagdad; it's a ruin now. It flourished when Confederates ran cotton from here to England, dodging Union gunboats.

Today, girls in shorts fish here for tarpon. Barefoot boys chase sandpipers, or drag a dead baby shark on a string. In warm, sunny winter, elderly Iowa and Missouri couples, chased south by cold and snow, wander along the beach looking for shells. Some take a boat for Padre Island, off the river's mouth, and talk with imaginative fishermen there about the buried treasure of Pirate Lafitte. Others hurry back for an enchilada dinner, across the river in Matamoros, or go to the movies.

Few indeed, near the Rio Grande's mouth, have any idea of what wild scenes, what mysterious Indian life, what mastodon bones, beaver, and snowdrifts are scattered up its 1,800 turbulent miles.

* See "The Texas Delta of an American Nile," by McFall Kerbey, in NATIONAL GEOGRAPHIC MAGAZINE, January, 1939.

NOT EVEN HER SUNBONNET CAN HIDE HER MILLION-DOLLAR SMILE

In the hot winds of west Texas summers old-style headdress still proves satisfactory. Even the greenest tenderfoot soon learns to avoid contact with dagger-pointed desert plants, like this yucca.

© National Geographic Society Kodachromes by Luis Marden

DESCENDANTS OF EARLY TEXAS SETTLERS GIVE A PIONEERS' CLUB PARTY

Round dances, in costumes of covered-wagon days, were held on the campus of Sull Ross State Teachers' College, at Alpine. Interesting relics of early days, from hand coffee mills to bullet molds and fragments of wagons burned by Indians, are displayed by the local historical society.

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Kodachrome by Luis Marden

DEEP, DARK SANTA HELENA CANYON MARKS THE BORDER BETWEEN BREWSTER COUNTY, TEXAS, AND MEXICO (LEFT)

Wild, rugged, and but sparsely inhabited, the Big Bend section of the Rio Grande was for years the refuge of renegade Indians, outlaws, and smugglers. Now new motor roads are creeping in, camping parties appear, and plans are afoot to convert the vast wilderness into an international park.

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$45,000 IN MEXICAN SILVER BARS REACH THE BORDER AT LAREDO, TEXAS

From Real del Monte Mines at Pachuca, these bars were hauled across the International Bridge in an open cart, unguarded. But try running with one in each hand; they weigh 72 pounds apiece!

Kodachromes by Luis Marden

SADDLE MAKING IS STILL A BRISK TRADE IN ALL RIO GRANDE COW TOWNS

Here Fidel Cantu, Laredo's veteran saddler, puts his final touches on the future pride of some broncobuster. Every good cowboy boasts his own expensive saddle, bridle, and spurs, and often his own favorite pony.

SINCE SPANISH COLONIAL DAYS PATIENT OXEN HAVE TOILED ON MEXICAN FARMS

Stubbornly disputing the right of way with motor trucks, such clumsy carts still squeak along. The peon keeps to the middle of the new Pan American Highway out of Nuevo Laredo, in Tamaulipas.

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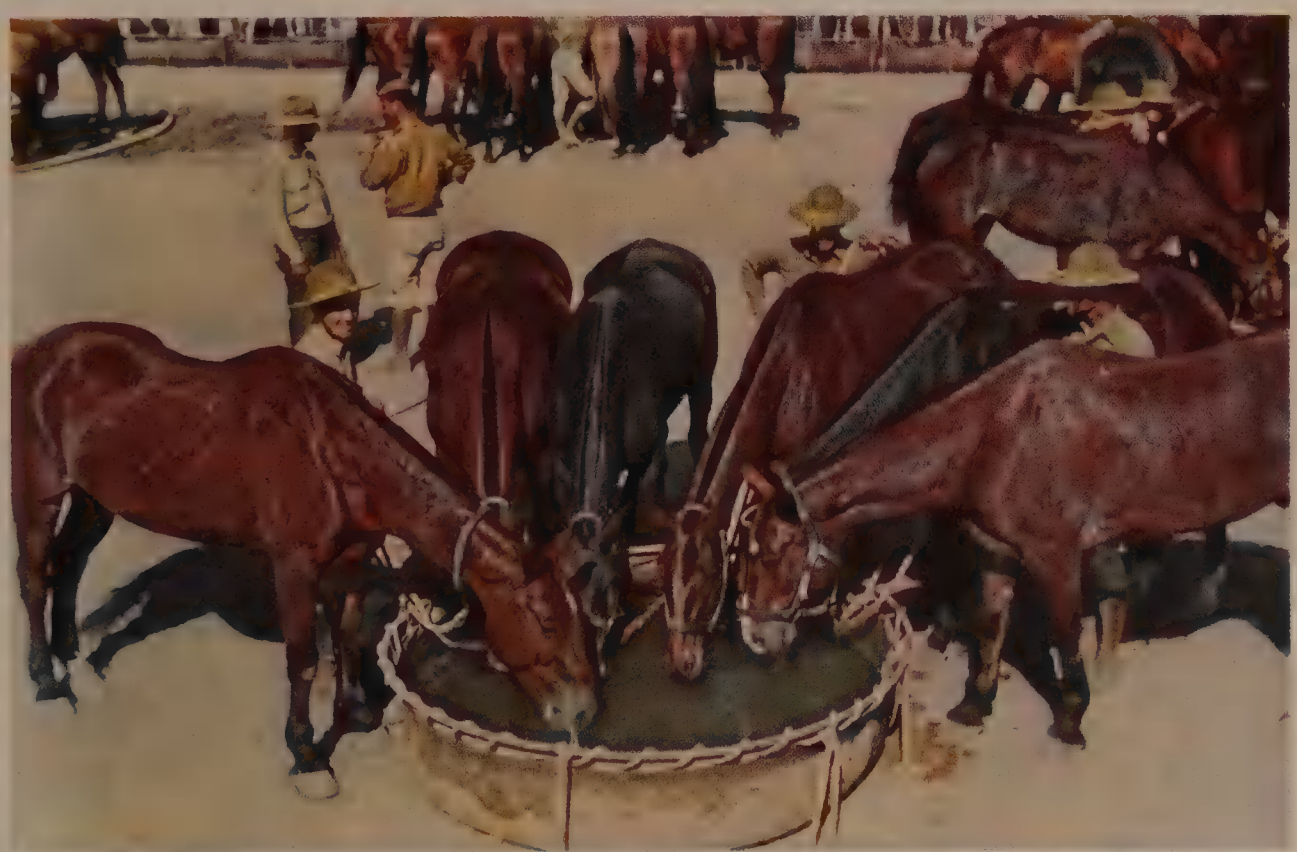
Kodachromes by Luis Marden

FERDINAND'S WIFE SNIFFS HAPPILY AT SUCCULENT CACTUS BLOSSOMS

With a gasoline torch the man burns the sharp spines off this nutritious Texas prickly pear. Then hungry cattle may eat the paddle-shaped plant without getting thorns in their mouths and tongues.

TO SEE THE LANDSCAPE WHIZ BY, ONE BOY RIDES BACKWARD ON THE "RUMBLE SEAT"

Too lazy to run away, this philosophical ass needs no bridle. After helping herd goats all day, he, too, is glad to go home and rest in Villa Acuña, in the Mexican State of Coahuila.



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UNCLE SAM'S TROOPERS WATER THEIR MOUNTS FROM A PORTABLE TROUGH

In maneuvers they marched from El Paso to San Antonio, a mere 600-mile jaunt. When water is warm from the sun, smart old horses sometimes poke their noses much deeper to get a cooler drink.

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Kodachrome by Luis Marden

ELEPHANT BUTTE RESERVOIR FORMED IN NEW MEXICO WHEN THE RIO GRANDE WAS DAMMED JUST BELOW THIS BLACK MOUNTAIN

For leagues downstream ranches and cities benefit from the flood-control and irrigation functions of the vast lake. Unique in a land of little water, it also affords fishing and bathing, and is one of the few places on the whole 1,800-mile-long Rio Grande where boats are used.

© National Geographic Society

"GOT A MATCH? MY PIPE'S OUT. YES, I KNOW 75 OTHER TRICKS"

Visitors to Alpine, Texas, halt in stupefaction when they meet this dog walking down Main Street alone, on its hind legs. Its master, who gives the orders, may be 50 yards away.

Kodachromes by Luis Marden

THE GREAT BARD SAYS, "THERE'S NO ART TO FIND THE MIND'S CONSTRUCTION IN THE FACE"

Of what this Navajo girl is thinking, then, you cannot read in her expression. It may be of another Navajo, or of a white girl's lollipop. She belongs to San Ildefonso, New Mexico.

MEXICAN SCHOOL CHILDREN CELEBRATE MAY 5, A NATIONAL HOLIDAY

On this day in 1862, during the first presidency of Juárez, valiant troops repulsed invading French at Puebla. Mexico's Independence Day is celebrated on September 16.

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Kodachromes by Luis Marden

"HOW'S THE ROAD FROM HERE TO MEXICO CITY?"

From Laredo, Texas, the Pan American Highway starts on its long drive toward distant Buenos Aires. In many lands, from Mexico to Argentina, sections are already built.

DEER OF THE WORLD

As Workers, Pets, and Graceful "Living Statuary" in Parks and Estates, These Versatile Creatures Have Endeared Themselves to Mankind

By Victor H. Cahalane

"WHO'S there?"

Deep in the mashed potato and chicken of Sunday dinner in the Chiricahua Mountains of southeastern Arizona, I took a few moments to reach the back door of my cabin.

The knock was repeated, this time more impatiently.

As I opened the door, there on the steps was an uninvited guest. Lowering his antlers, he advanced to knock again. I stepped back while he peered into the room expectantly.

Behind him lay the wreckage of our Sunday dessert. Rolling in the dust was the empty ice-cream freezer. Chunks of ice, licked free of salt, were scattered over the ground. The yawning container informed my wife that it would be necessary to open a can of peaches.

Apparently the palates of deer had undergone a vast change since their prehistoric ancestors inhabited the earth!

About 25 million years ago the predecessors of the modern deer wandered over the vast wastes of a primitive world. They had no horns and were neither so handsome nor so large as their descendants are today. No bigger than cats, they scurried through the Oligocene forests, fighting their battles with long saberlike teeth. Somewhere in those lost, mysterious centuries the structure of the deer changed gradually. Most of them grew larger and developed antlers.

DEER AMONG EARLIEST PICTURES

Among the oldest pictures in the world are those of antlered deer carved or painted by our Paleolithic ancestors 50,000 years ago. Some of the deer were 16 pointers!

During the thousands of years slow changes of climate took place. The reindeer of the cold regions and the red deer of the warm regions wandered south and north from their respective homes as the glaciers advanced and receded over the earth. As land rose up out of the waters joining continents, the deer originally inhabiting central Asia probably migrated south over the mountain ranges through northern Iran (Persia) to the Caucasus, and through Asia Minor to the Balkans.

Crossing the Alps, they reached central Europe. From there they moved on to England, or to Ireland, or the Americas. The waters rose again from time to time, sweeping over the land bridges. As the deer became thus isolated, they adapted themselves in form and habits to their new environments.

Modern man has often greatly accelerated the migration, bringing species from one country to another. In the *Gallic Wars* Julius Caesar wrote about the "elch." An early form of the present Spanish bull fight is recorded by Julius Capitolinus' description of 10 elch appearing in the arena with gladiators. The Romans brought the fallow deer to England; the homesick Scots shipped their stag to New Zealand; reindeer were imported to Alaska; and several other species of deer were sent to newly developed countries.

NEARLY SIXTY DEER TRIBES IDENTIFIED

Primitive man knew only a few kinds of deer, but today exploring scientists have named nearly sixty. These are distributed over the entire world, with the exception of central and southern Africa. Although they differ greatly in size, from the vast moose six and a half feet at the shoulders to the dainty little pudu only twelve inches high (Plate VII), there are certain common family characteristics.

The males of all but two species proudly display antlers. In the cold and temperate zones they use these to fight bravely and gloriously in the fall, lose them meekly in the winter or early spring, and devote the next few months to growing new ones for further conquests. Perhaps the struggle is less strenuous in the Tropics, for there the shedding frequently has no fixed period.

"What becomes of the antlers that deer cast off every year? Why don't we see them?" everyone asks.

Photograph by B. Anthony Stewart

FOR A HUNGRY FAWN—THE MILK OF HUMAN KINDNESS

On the road to the summit of Mount Tamalpais, California, a clever young deer is willing to "strut his stuff" to earn an honest meal.

Fortunately the horns either provide calcium for millions of rodents or eventually rot into the ground.

The only species of deer which do not have horns are the musk deer and the little Chinese water deer. These two are equipped instead with long canine teeth, which they wield as mercilessly in their small battles as their cousins wield their antlers.

A few of the European and Asiatic deer wear handsome spots, but the rest of the tribe are clad in plain browns with various shadings. Given new coats twice a year, they have a heavy, warm attire for winter, and a light, cool one for summer. When it is time to change, they rip off the old apparel by degrees, tearing patches here and there on bushes and briers. At other times well dressed, they appear badly moth-eaten at the end of each season.

Deer are ordinarily vegetarians. Although they are supposed to confine themselves to browsing and grazing, they enjoy all the vitamins from A to D. When they come in contact with the ubiquitous traveler, I have watched them develop appetites for chewing gum, tobacco, oranges, cantaloupes, fried eggs, bacon, tapioca pudding, chocolate bars, ice cream, wrapping paper, and much other foreign matter.

Virginia, or Whitetail, deer (Plate VI), have been known to eat fish, and an elk has been seen gnawing a ham bone. Apparently, however, they draw the line at onions. I remember a deer which, when offered one of those tear-jerking vegetables, lifted his hoof, slapped the donor's wrist in sharp reproof, and walked away disdainfully.

A BUCK COMPLAINS OF PICNIC FOOD

Since they are not usually loquacious, I was astonished upon coming out of my cabin in Sequoia one day to hear a buck complaining long and loudly. He could have been heard a hundred yards away. With short querulous bleats, he kept up a continuous lament as long as he remained within hearing distance. His distress was probably not caused by his emotions but by the state of his stomach. If he only had known it, a strong cathartic or abstinence from the vacationists' menus would have given him complete relief!

All deer must have salt. Large holes in saline clay are found licked smooth by their rough tongues. Imagine the joy of the deer which find this necessary item of diet rained like manna out of heaven. In vast game areas managers recently have dropped from airplanes, facetiously called "the flying salt cellars," blocks of salt for artificial licks.

Deer have a strong sense of curiosity and will frequently investigate any unusual motionless object. Hunters say the does are more inquisitive than the bucks.

Usually forest and woodland creatures, most deer love the water. They are powerful swimmers and do not hesitate to dive under floating logs and other obstacles. The gregarious species of deer are often

Drawing by Walter A. Weber

ANTLER-OGRAPHIES OF THE BULL WAPITI (LEFT) AND MOOSE

The upper six sketches show growth from the simple budlike beginning in early spring through an intermediate to an advanced stage in the velvet. The velvet, a hairy, fleshy skin laced with blood vessels, carries nourishment and building calcium to the growing antlers. It takes about four months for them to attain full growth and two months to harden. In early fall, at the end of the hardening period, the bull rubs off the velvet against trees and branches. Each year, after the rutting season (time of mating), the antlers are shed.

Photograph by Lomen Brothers

SLED BELLS JINGLE AS A SWIFT AND POWERFUL REINDEER TROTTER RACES DOWN THE FROSTY HOMESTRETCH

The big deer, originally introduced to Alaska from Siberia, has greatly multiplied and furnishes transportation, food, and clothing to thousands of Eskimos.

Photograph by H. W. Terhune

HEADS UP, HAUNCHES IN, ANTLERS OUT IS GOOD FORM FOR CARIBOU SWIMMING THE UPPER YUKON RIVER IN ALASKA

Photograph from Wide World

AN ALBINO REINDEER TRAILS A HERD GUIDED BY "DEER-PUNCHERS" IN A BOAT PAST A CRUISE SHIP VISITING NORWAY'S COAST

Photograph by H. F. Mielenz

HURRYING HOOFS PACK THE SNOWY DEER TRAIL AS STARTLED WHITETAILS DASH THROUGH WISCONSIN'S NICOLET NATIONAL FOREST

The bucks have already shed their antlers and therefore are indistinguishable from the does. Each deer was "stopped" by the camera in a different part of its stride.

© International News

BARNEGAT PETE "WHISPERS" SECRETS TO A BOY FRIEND

The pet deer "making up" to Byron Eno is well dressed in checkered blanket and flashy necklace, with his identification tag for a breastplate. He sleeps in a local store and romps with village children and dogs. During the hunting season, townspeople keep a close watch on his wanderings. Pete originally came to Barnegat, New Jersey, to escape a forest fire.

Photograph courtesy U. S. Department of the Interior

ONE HUNDRED PER CENT DEER APPEAL

Visitors to our national parks find it hard to resist such a shy, trustful, and wistful expression. Rangers and administrative officers continue to discourage offerings of bread, waffles, flapjacks, and similar tidbits, which are actually bad for the deer. More serious, however, is the fact that every year a great many well-meaning but thoughtless travelers are injured by flying hoofs or tossing antlers.

Photograph by S. N. Leak

REARING TO SLASH WITH THEIR FORELEGS, WAPITI BULLS STAGE A GRUDGE FIGHT

Most of this herd assembled in the Jackson Hole country of Wyoming shows no interest in the scrap. The wapiti is the most polygamous of American deer. If he is strong and skillful enough to fight off jealous rivals, a single bull may keep a harem of as many as 60 cows. Severe winters still take heavy toll of this American elk, because the animals have been dispossessed of their natural foothill and lowland range (page 485).

seen splashing one another and apparently playing water games.

On land they delight in a game of tag and "follow the leader." There is also a sort of dance in which some of them indulge. Keeping their noses close to the ground, the wapiti and moose trot with occasional galloping steps in circles sometimes 30 feet in diameter. The European roe has a courting dance in which the bucks pursue their ladies in circles.

Like white flags of distress, the upraised tails or hairs of the rumps of some species of deer fly among the trees, communicating alarm. Variously shaped according to their environmental needs, their feet often have scent glands that leave a message of warning as they race away from danger. Even a Scottish stag has been seen rapping his companion's shoulder with his forefoot to direct attention to an approaching enemy (page 473).

They have differently pitched cries for calling their mates, scolding their children, bugling a challenge to battle, bleating fright or pain, and snorting or whistling rage and disgust. These ejaculations are also made at times to frighten a possible enemy.

One still summer morning I was recording survey data on a forest-covered slope of Mount Toby in central Massachusetts. For a half hour I had been perfectly quiet except for my hand moving over my notebook. Down the hill just in front of me a stick snapped. I realized that something was slowly circling me. Nothing could be seen through the thick tangle of brush.

A DEER'S "BOO" IS STARTLING

Suddenly, without any warning, a piercing whistle sounded just behind me. It was the most hair-raising shriek that had ever been breathed down my neck. I practically jumped out of my shoes and turned just in time to see a whitetail leaping away through the tall brush.

Deer have trouble identifying motionless objects when there is no wind to carry scent. Probably she had been unable to tell what I was and had whistled to make me move. She succeeded!

Affectionate creatures, they often rub noses as if questioning and assuring each other of their mutual regard.

Although the mating season is in the fall, I have seen the white fallow deer apparently making love in the early spring. The creamy coats of the dainty, slender creatures change to a gleaming white and their ears to a soft translucent pink in the sunlight. Long, thick, white eyelashes fringe their dark eyes.

One of the stags I watched last year had a particularly beautiful antler spread. He bent gracefully over his lady, caressing her head, face, and throat. Occasionally he lifted his right foreleg and stroked her gently. She responded a little, but seemed more interested in observing the landscape.

The other does were restively jealous. They approached and tried to attract the stag's attention. Driving them off impatiently, he returned to his favorite, but she became bored with his demonstrations, arose, and moved languidly away.

Obviously discouraged by her inattention, he followed. When the watching does again attempted to beguile him, he ignored them. He consoled himself by talking it over with the other stag.

There seems to be no rivalry at this season. The two stags rubbed noses and shook their horns in agreement. "These females!" they seemed to say. Of course skeptics may observe that this was not a love scene but a grooming process.

The deer is a polygamous creature. One species may take only a single spouse at a time, but soon tire of her and rush off to acquire a new consort. Another, like the wapiti, will maintain a large harem during the mating season and stand ready to fight any male which attempts to steal one of his ten to sixty wives.

PREPARATION FOR BATTLE

Early in the fall, or in whatever season their rut begins, the stags free their horns of velvet, and sharpen and polish them for battle. The yearlings begin practicing the mighty war cry of their elders.

There are comparatively few fatalities, because most bucks feel that discretion is the better part of valor. The weaker males think twice before confronting their superiors. Even during the combat, a losing animal will often take to his heels at the first opportunity and the winner is satisfied to let him go.

Sometimes a deer will hang about a harem waiting for a bolder and stronger buck to challenge possession, hoping that he may acquire a doe or two while his betters are engaged in battle. A Wyoming elk was once seen driving a herd of 66. A lone bull followed, but did not dare to make a raid. One wonders why two or three do not join forces against the powerful possessor of such a large harem. Perhaps there are certain rules of the game.

It is not always the strongest that wins. Sometimes the quicker, more agile, or more clever sultan can keep the greater number of concubines. Even an abnormal stag without horns has been said to keep his hinds from all comers.

More of a wrestling match than a duel, the conflict is a grueling test of supremacy. Eyes bloodshot and neck swelling, the male plunges through the forest tossing his antlers and challenging his fellows to battle. Impatient for conquest, he slashes angrily at the trees and underbrush.

Upon encountering a rival, he lowers his head and charges. The contestants come together with a terrific crash. Antlers locked and heads down, they shove and push. Pawing frantically, they tear up the ground with their hoofs, trample bushes, and uproot small trees. They writhe and toss, the whites of their eyes rolling.

Again and again they break their lock and lunge at each other for stronger holds. Their muscles strain, their horns are wrenched, they puff and pant.

HORROR THE AFTERMATH OF VICTORY

If the losing stag does not take to flight, his antlers will be broken, or he will be brutally gored to death. Sometimes the horns become inextricably locked, and the combatants are grappled together in a hideous torture that means slow death to both (page 480).

The blood of three husky sportsmen ran cold when they saw the result of such a climax approach them a few years ago. Wearily and painfully a stricken buck dragged himself from tree to tree trying to feed himself. Locked in his battered horns, he carried the grisly head and antlers of his last opponent. Coyotes had devoured the body of the vanquished deer, but the winner had managed to kick them off.

The males eat little during the rutting period and are beaten, worn-out creatures at the end of the season. All rivalry ends,

Photograph courtesy U. S. Department of the Interior

A PARK RANGER MEETS WITH WOODLAND ARISTOCRACY IN A ROUND MEADOW CONFERENCE

California mule deer, curious like all the family, give their host the "once-over" in Sequoia National Park. Bucks in the foreground have scraped their antlers clean; those behind are still in the velvet.

and grievances are forgotten. Those which live in herds often submit to a matriarchal system. Led by a wise old hind, and with other hinds for guards, they rest and restore their health for a new season.

Most prolific of all the species are the little Chinese water deer, which have four to six fawns in a litter (Plate XV). Other deer mothers give birth to one or two infants at a time and rarely triplets.

Generally the babies are spotted and do not have the strong odor of their parents to betray them. The doe hides them during the day, returning to nurse them, or, as they grow older, to take them abroad at night for food.

Until the offspring can understand his mother's orders, she pushes him with her nose or chin to make him lie down. If he is contrary-minded and needs discipline, she administers a hasty wallop that brings immediate obedience. He soon learns to drop in his tracks and stay motionless at the first sign of danger. Although fawns are usually well hidden, I once found a little one lying flat in the wheel ruts of a road, blissfully unaware how conspicuous he was.

Unlike bears, which are interested in no children but their own, deer mothers sometimes adopt the orphans. A few years ago, an elk was seen flying up a steep hill leading

Drawing by Walter A. Weber

FORE AND AFT, THEY CARRY THE FEATURES BY WHICH THEY ARE KNOWN

The artist has drawn antlers, tails, and hind legs of three species of American deer. Bifurcated antlers and a tail black above and held straight out behind in running characterize the Columbia blacktail deer (left). The Virginia, or whitetail, deer (center) carries antlers with dominating main beams from which the unbranched tines rise vertically. The large tail is pure white underneath and held high as its owner bounds along. Resembling the blacktail, but with distinctly larger and more widely spreading antlers, the mule deer (right) bears a black horseshoe-shaped patch on the forehead. Its tail is white with a black tip and is held down in running. On the side of each hind leg appears the leg gland (metatarsal gland)—about three inches long for the blacktail, one inch in the whitetail, and approximately four inches long for the mule deer.

four calves. Deep snow held the youngsters back, and finally they could scarcely make headway.

HEROISM OF A COW ELK

Looking back, the elk saw their predicament and realized that they would never be able to make an escape. In spite of the danger to herself, she retraced her steps and, pushing the youngsters with her forefeet, forced them to turn back and take a less difficult route.

The "good neighbor policy" does not always apply to deer, however. In the mountains of Arizona, I once watched a group of does and their fawns. One of the cocky youngsters tired of his mother's brand of milk and began to look around for new horizons. Making a cautious tour, he watched the gustatory delights of his playmates with envy. At last he got up enough courage to edge experimentally up to his best friend's mother. With a swift, well-placed kick, she sent him flying into the

Photograph by Ben East

MOTHER MOOSE BACKS UP HER CALF AS THEY COME ASHORE AFTER A LONG SWIM

When weary, the youngster may cling to the maternal rear. This scene was snapped at Lake Richie, on Lake Superior's Isle Royale.

Photograph by Frank W. Childs

PLAYFUL SPARRING BETWEEN MOOSE MAY BE ONLY PRELIMINARY TO A VICIOUS COMBAT IN WHICH ANTLERS SPLINTER AND FUR FLIES

© George Shiras, 3d

ONE OF THE MASTERPIECES WITH WHICH GEORGE SHIRAS, 3D, FIRST DREW ATTENTION TO THE ART OF ANIMAL PHOTOGRAPHY AT NIGHT

This picture of a doe and her twin fawns feeding on a lake in Michigan was exhibited with nine others by the United States Government at the Paris Exposition. The group received the Gold Medal. At the World's Fair in St. Louis it won the Grand Prize.

Photograph by Fred Armbrister

NICE WORK—IF YOU CAN GET AWAY WITH IT!

In Banff National Park, Canada, a forest lord licks up a food offering from a man's cupped hands. Moose frequently attack humans, often without apparent provocation. Small new antlers in the velvet give no hint of the massive many-pointed palms they will grow to be.

bushes. He bleated a sharp cry of surprise and humiliation, scrambled back to his mother, and thereafter stayed at home.

Bears have been known to kill small fawns, and mother deer will not tolerate their presence knowingly. A ranger in Yellowstone National Park once told me about a mother elk which charged furiously into the woods one day, her ears laid back and the hairs of her ruff standing upright. Hastily scrambling up a tree, a black bear narrowly dodged her. Snorting with anger, she went back to feeding with her baby.

As they browsed farther and farther away, the bear decided that it was safe to descend. He got cautiously to the ground and tried to sneak off. But the elk had seen him. With a rush she was almost upon him, striking angrily. Bruin climbed back up the nearest tree, his tongue hanging out in the efforts of his hasty ascent. The elk shook her head warningly and returned to her repast, casting an occasional malignant eye on the prisoner.

The minutes went by, and the bear made another attempt to escape. As he started to clamber down the trunk, the elk turned and with a look sent him hurriedly back to the branches. The bear made several further attempts to get away as the afternoon wore on, but never achieved more than a few feet of progress until the elk wearied of feeding and ambled off with her child. Any man who has been chased by a bear would have relished watching this rascal being treed by an elk.

Always suspicious of human beings, a mother moose became very angry when she discovered another ranger in Yellowstone National Park attempting to extract her calf from a deep quagmire. She rushed forward, charged the ranger up a tree, and proceeded to rescue the child herself. Snorting angrily at both man and offspring, she stalked off.

RARE THE BUCK THAT KNOWS HIS SON

Except for the roe buck, most male deer never recognize their own offspring. Even gregarious bucks which herd with the does and fawns show no concern for the young, but let them shift for themselves or run to their mothers.

Toward the end of a long, hard winter in Yosemite, several mule deer does must have been greatly surprised when one of

their mates displayed an uncustomary interest in the performance of parental duty. A hungry coyote had been slinking about the edge of the herd apparently trying to pick off one of the weakened fawns. Desperately worried, the deer mothers ganged up on this marauder. They circled around him, and finally trampled him to death. When the killing was over, a handsome buck appeared. With a lordly gesture of finishing a noble deed, he ostentatiously tossed the mangled corpse over his antlers. There are perhaps other exceptions to this general indifference of the stag. A fawn being pursued by a coyote was recently seen running to a lake, bleating with terror. He plunged into the water and began swimming toward the opposite shore. The coyote, which has an atavistic dislike for water, sped around the lake and reached the other side just as the breathless little fawn arrived.

A buck had been watching the chase. Whether some paternal spark was struck or whether he was in a mood for fight, he charged the coyote with lowered antlers. Immediately losing his appetite for fresh meat, the coyote beat a hasty retreat to the hills.

Deer all over the world have their four-footed enemies: wolves, coyotes and other dogs, members of the cat family (tiger, puma, and jaguar), and several kinds of bears.

In Europe and North America, south of the Northern Plains, or Barren Grounds, their greatest enemy has been, outstandingly, man. With the rise of population in Europe, beginning about the time of Charlemagne, the forests were cut down and fields cleared for tillage. Wild life was not only killed off faster than it could reproduce, but its home was destroyed. A similar story was repeated in the settlement of North America. Deer and elk were killed by the hundreds of thousands, many for their hides alone, many for the sheer lust of killing.

PESTS, NOT HUNGER, KILLED DEER

Deer are subject to diseases and numerous internal and external parasites. Pneumonia, certain trypanosomes, ailments transmitted by domestic stock (hoof-and-mouth disease, scours, rinderpest, anthrax), lungworms, liver flukes, intestinal worms, nose fly larvae, bots, ticks, fleas, lice, and biting flies are some of the afflictions for which they have no remedy but time.

When I was mammalogist for Michigan several years ago, a great disturbance was raised throughout the State by indignant sportsmen. It was late winter. Snow was still on the ground. Hundreds of deer were dying. The Department of Conservation was accused of parsimony and failure of duty.

"Deer Starving to Death!" "Deer Must Be Fed!" "Put the Deer on the Dole!" "Michigan Deer Facing Extinction!" shouted headlines over news stories from hunters and humane societies.

Upon investigation I found that the dead deer, though emaciated, had full stomachs. They had died of pneumonia, cold, and exposure.

The following summer I found an outstanding cause of their weakness and susceptibility. The nose of every deer that I examined in that part of Michigan was nearly plugged with nose fly larvae. Flies of the genus *Cephenomyia* had laid their eggs in the deer's nostrils. The eggs hatched. With little hooks bestowed by a paradoxical Nature, they clung fast. However hard the deer tried, they couldn't sneeze the tormentors out. The parasites burrowed deep, constantly sucking blood and growing fat. When mature, they left their bed and board without farewell or thank-you and dropped into the ground to pupate. Their unwilling hosts, weakened by loss of blood, faced with an almost overwhelming handicap the adversities of life and more flies.

The life expectancies of these deer range from three to fifteen years, or possibly longer, according to the species. Even if they survive disease and their enemies' attacks, their precarious lives are made up of one accident after another.

Like humans, they can make a fatal slip in their bathtubs. Many a moose has skidded and bogged down in a lily pond, never to rise again. Three yearling elk, pursued by a mountain lion, once leaped into a hot spring in Yellowstone National Park. Unable to move their feet, they sank, and, standing upright, were drowned, and slowly and horribly cooked.

Deer of the northern countries break through the ice and, unable to climb back, are drowned and frozen as the ice thickens. Snowslides may trap or cover them. All over the world they leap from cliffs in terror-stricken fright, impale themselves on sticks or sharp branches. One monarch was

found pinned to the ground when a falling tree had caught his antlers. Starvation and predators slowly and ruthlessly ended his life.

"MUSIC HATH CHARMS"

Occasionally deer have been hunted with a violin. Perhaps they have an ear for music! In Europe, hunters have attempted to lure the animals to within shooting range by hiring a violinist to kneel in the bushes and play his instrument. (One wonders whether Debussy might be more successful than Chopin!) A moose in Sweden became so enraged by the playing that he charged into the blind and killed both hunter and musician.

An American photographer was much more successful. The moose, annoyed at being posed, lowered her head and made every motion of charging. The photographer bravely whistled and the moose stopped stock-still. Apparently enchanted, the animal relaxed and seemed to assume an air of pleasantly critical audition.

The photographer continued his repertoire and edged himself up into a tree—just to be on the safe side. In his excitement, however, he dropped his camera. Not impressed sufficiently by the musical performance, the moose refused to let the whistler come down to retrieve his loss, but kept him treed as long as she desired to feed in the neighborhood.

Campers have observed that elk apparently enjoy radio music, but show their disdain for man's mind by refusing to listen to his speeches.

Since the fifth century reindeer have been domesticated.

ESCAPING CRIMINALS USED REINDEER

When Charles IX ruled over Sweden, European elk (closely related to our own moose) were tamed and trained to carry couriers many leagues a day. Because of the great speed of these animals, numerous criminals escaped and it became necessary to declare transportation by means of elk illegal in the 17th century.

Throughout the ages deer have been hunted. Prehistoric man ate their flesh, warmed himself in their hides, made ropes from their tendons, harpoons and hammer heads from their antlers. During the mid-Neolithic period the horns were used as picks to shaft-mine flint and later for handles of less primitive weapons and tools.

In medieval battles, fighters were equipped with slings of European elkskin for hurling stones and other missiles. Later the skins of elk legs were ripped off carefully to provide gun sheaths and powder pouches. Elkskin jackets, being tough and heavy, were at first believed to be bullet-proof. People of eastern Siberia sent tribute of thousands of elkskins to the Chinese, and Russia paid war indemnity to Austria in many hundred wagonloads of skins. The elk in Poland are assumed to have been exterminated because Paul I, Tsar of Russia, ordered his cavalry equipped with elkskin breeches.

The thick coarse hair of the European elk, musk deer, and others have filled many cushions and padded many saddles. Their fat is still rendered into grease and candles. Hides of deer all over the world are in continuous demand for fine leathers. Implement and umbrella handles, furniture, chandeliers, decorations, glue and cloth sizing are manufactured from their antlers. An additional and great source of revenue is the sale of hunting licenses.

Many ancient "remedies" were made from the European elk, musk deer, and others. They ranked as high as patent nostrums in the United States today, but most of them were worse than useless. At that time a doctor could supply his entire practice from the proceeds of one animal.

The left hind foot removed from a living elk was believed to be a cure for epilepsy if part of it were worn about the sufferer's body, ground up in wine and imbibed, or burned and inhaled. The antlers would do almost as well if they were taken the first of September. If obtained at an earlier date while still growing and at a tender stage, the horns were sliced and steeped with herbs and spirits for treatment of snake bites. The animal's fat made an efficacious ointment, and his heart when ground or burned was considered a sure cure for heart troubles. The approved treatment for arthritis, rheumatism, and cramps was dried nerves wrapped about the afflicted limbs. This was supposed not only to cure, but, if worn continuously, to prevent further attacks!

The musk deer is still in great demand by the Chinese for the manufacture of medicine, and in April, 1939, its musk was used in one of the New York hospitals for a persistent form of hiccoughs.

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Painting by Walter A. Weber

ACROSS A MISTY LAKE, AN ALASKAN BULL MOOSE CHALLENGES A RIVAL

This lordly animal is closely related to the common moose, which patrols the northern wilderness from Maine and Nova Scotia to the Arctic Northwest. During the mating season in autumn, forests echo with the clash of broad, palmated antlers as powerful bulls battle for the cows. Twenty-seven deer from many parts of the world are presented in this series painted specially for the NATIONAL GEOGRAPHIC MAGAZINE by Walter A. Weber.

INTERLOCKED ANTLERS TELL A TALE OF RIVALS' DEATH

Mr. George Shiras, 3d, holds two 50-inch pairs of moose antlers which he found at St. Ignace Island, Lake Superior. During a mating season battle, the animals literally "locked horns" and could not pull apart. Death soon vanquished both (page 471).

Alaska Moose

Alces gigas

Awkward and grotesque in appearance, the moose are the largest and most powerful deer in the world. These huge, heavily coated creatures inhabit the cold northern lands all the way around the Pole. On this continent moose are found throughout much of Canada south and west of Hudson Bay, in Alaska south of the Arctic Circle, on the northern fringe of the United States from Maine to North Dakota, and south in the Rockies to west-central Wyoming. In the Old World, elk (European moose) range from northern Norway and Sweden eastward through Siberia above latitude 50° to Amurland, with a few in East Prussia and Livonia.

Of the species of moose that inhabit this vast stretch of two continents, the greatest of all is the Alaska (Plate I). Weighing sometimes almost a ton, he reaches the tremendous height at the shoulders of 92 inches—nearly eight feet! Towering beyond his massive head are the heavy palmated antlers that may spread six feet more.

Neither beautiful nor graceful with his heavy, overhanging muzzle, long legs, thickset body and hunched shoulders, this dark, ponderous giant has a certain magnificence of size and force as he trots effortlessly over alder swamps and crashes through windfalls of the northern forests. However, despite his long legs, he customarily passes his life in one permanent home, confined to a radius of ten miles.

During the rut when the cow calls invitingly and the bull rushes about madly, he takes several mates, but keeps only one at a time. In this season hunters frequently decoy the bull into rifle range by imitating the low blatting love call of the cow.

Having torn up the ground and broken down trees in titanic battles for his wives, he often meekly settles down for the winter with one of his consorts, docilely tolerates a stepson or two, and presents a picture of exemplary domesticity.

Moose calves, generally twins, are born in May and are reddish brown without spots. They stay with their mother until she drives them off the following spring,

just before the arrival of her new babies.

Smaller deer must often stand on their hind legs and reach into the high branches with their forefeet for their meals. The long-legged moose does not have that difficulty, but is annoyed by the necessity of reaching down six feet to a dinner table of grasses. He has been seen to rest himself by kneeling and hunching along to feed. He is fond of leaves, shoots, and twigs of hardwood trees and balsam, and is often seen reaching below the water or diving for water lilies and other aquatic plants. During the summer months he swims for miles in cold spring-fed lakes. Even a young calf will attempt a long water trip. If he gets tired, he will grab hold of the rear of his mother and hang on for dear life.

Reindeer

Rangifer tarandus

Wearing fur coats that act as air cushions on the water, and outfitted with SOS signals, snowshoes, and skates, the Old World reindeer and American caribou are equipped to travel a hundred miles a day (Plate II). Built on a warm foundation of thick fat, the hair of their coats gives extra warmth without extra weight, waterproofing them, providing buoyancy to hold them high in the water, and giving them a faster swimming speed than any other deer. The raised white tail and surrounding patches of white act as signals of alarm.

In a land of deep snow, the hoofs and slender legs of an ordinary deer would sink helplessly. Reindeer and caribou, however, have hoofs which cut the ice like skates, and which are large enough to act as snowshoes. Greatly developed false hoofs, or dewclaws, located low on the "fetlocks," are of further assistance.

THE MYSTERY OF THE SOUND REINDEER MAKE ON THE HOOF

When walking or running, the Old and New World reindeer produce a clicking sound, so loud that it can be heard a hundred feet away. Some zoologists believe that when the 300-pound weight of the animal is released as a stride is begun, the spread "claws" of the hoof "click" together. The other school insists that the sound is produced as the weight settles down on the foot, not when it is removed, and that the sound therefore comes from knuckle-cracking movements of the bones within.

Reindeer thrive under conditions and on fare that would quickly exterminate less hardy animals. The only deer to have warmly covered muzzles, they paw and nose through the snow for lichens and mosses when the low wind-flattened shrubs are no longer available.

The sole females of the deer family to have equal rights and standard equipment of antlers are the reindeer and caribou. They keep them longer than the bucks, until about the time the babies are born in May or June—when they abandon all vanities and concentrate on motherhood. As a matter of fact, they need these horns in the terrific competition for food during the winter months. The snow is often too hard for them to penetrate and they must use their antlers to push aside the stronger, unchivalrous males which are able to uncover plenty of food.

For the Lapps and other inhabitants of northern Norway, Sweden, Finland, Russia, Siberia, and of Spitsbergen and other large Arctic islands, reindeer are the chief wealth and the staff of life. Without reward of food or shelter, they provide tireless transportation and milk. One calving female yields daily about three cups of milk, which is drunk, cooked, or made into cheese and butter. Since there is no maintenance except herding, even a poor Lapp can afford a fair-sized herd. When killed, the animals furnish meat, clothing, and many other necessities of life.

Covered with soft gray coats that are almost white in winter, reindeer stand 42 inches high and weigh 300 pounds. They are caught when wild by the use of a trained male or female as decoy. Both adults and fawns are marked by cutting or biting out ear notches, and then trained into semidomesticity. Not kept under cover or within fences, they wander about, feeding themselves. If the owner wants a pint of milk or a ride, he goes out to the tundra and lassoes one of the animals.

If lonely and desiring to visit another, the Laplander harnesses a deer to his boatlike sleigh by means of traces fastened to a belt around the animal's neck, and goes merrily off through the dancing ice crystals at nine or ten miles an hour.

In the early 16th century, when long-distance travel by reindeer was a serious business, a traveler had his hands full. Tied by his feet in a boat-shaped carriage so that he would not fall out (and praying that the conveyance would not overturn), he held the reins in one hand and a guiding staff in the other. After a certain number of miles, the reindeer was let loose to return to his owner and a fresh deer was yoked to the sledge.

For impoverished Eskimos reindeer were introduced into Alaska, where they became locally overabundant. As the Alaskan Eskimos waxed fat on their new reindeer industry, the food supplies of the Canadian Eskimos dwindled to almost nothing. On Christmas Day, 1929, ten men set out to drive 3,000 reindeer north and east from western Alaska on the Arctic Circle to Canada's coast on the Arctic Ocean. After nearly four and a half years of almost superhuman efforts and incredible hardships, they reached their destination. Only 10 per cent of the original herd had survived, but five fawnings had helped to replace the dead. It was a colossal undertaking, of too great a magnitude to have been tried before or likely to be attempted again.

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A NOMAD LAPP HITCHES DONDER AND BLITZEN TO HIS BOATLIKE SLEDGE

Staff of life to thousands of northland dwellers in Europe is the domesticated **Reindeer.** Vast herds descended from introductions now roam Alaska and Arctic Canada to serve the Eskimo. Several dig with hoofs and noses for grass, mosses, and lichens beneath the snow (background).

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AS CARIBOU RACE FOR COVER, AN INDIAN HUNTER'S ARROW FINDS THE HEART OF A SPLENDID BUCK

Caribou are the reindeer of North America. There are two main groups: the **Woodland Caribou** (shown here), and the smaller gray Barren-Ground type, with longer, but more slender, antlers. Original range included most of Canada and Alaska. The Woodland species is fast diminishing, while the Barren-Ground is still relatively abundant in some regions. Not so swift in a sprint as moose or whitetail deer, the caribou migrates over far greater distances.

Photograph by Frank W. Childs

BULL ELK ENJOY HOT-WATER HEATING IN THEIR WINTER HIDEAWAY

Splendidly crowned with full-grown antlers, two male wapiti, a doe (head hidden by snow bank), and a fawn (head just visible) in Yellowstone National Park stand in a brook fed by warm springs. Eight-foot-high walls of deeply drifted snow cut off cold winds. For food, there is dry grass clinging to the stream banks.

Woodland Caribou

Rangifer caribou

The North American caribou, the reindeer of the New World, are found over Alaska, most of Canada (except southern Ontario, Saskatchewan, and Alberta) and on the larger islands of the Arctic Ocean and the coast of Greenland. The small, pale species north of latitude 60° are called Barren-Ground caribou *(Rangifer arcticus)*; the large dark ones of the Rockies are aptly termed mountain caribou *(Rangifer montanus)*; and the southern and eastern forest dwellers are the woodland caribou (Plate III).

A few of the mountain form still range in the wilderness of eastern Washington and perhaps in northern Idaho. Woodland caribou once lived in Maine, northern New Hampshire and Vermont, northern Michigan and Minnesota; but these were exterminated years ago except for a dozen or so in the Quetico-Superior lake country of Ontario and northern Minnesota.

Perhaps because of the abundance of moss and lichens, the woodland caribou are much larger than the reindeer. With the exception of the white Newfoundland species, they are also much darker in color. Trimmed with heavy, yellowish-white manes, their dull grayish-brown winter coats become a deeper brown in summer. Although six inches taller than the reindeer, they are less chunky. The bucks weigh only 200 to 300 pounds and the does about fifty or sixty pounds less.

In early October the caribou mate and scat-

ter over the country, two or three cows with a bull. Soon they gather into larger bands of five to twenty. Through the long winter they wander along the desolate hardwood ridges, descending into the tamarack and cedar swamps to avoid the coldest winds or heavy snow. By June the bands have again broken up into ones, twos, or threes, and the does fawn in solitude. The single youngster is colored much like his mother, with faint indications of white spots. Unlike most fawns, he is never hidden, but precociously follows her over the tundra a few hours after his birth.

Caribou are much wilder than reindeer. Any one region is seldom home for long to these species of the New World. They are probably the most migratory of all the deer, drifting like ghosts through the snowy forests or wandering over the scrub-covered tundra, urged on by mysterious vagaries. Their difficulty of comprehending new dangers, such as the white man's firearms, may some day spell their doom. The once vast herds are already greatly reduced.

Some time in July, for two weeks or so, many thousands of these mysterious creatures journey through Mount McKinley National Park, Alaska. Even from the motor road the visitor may see the continuous procession moving in groups, bands, and herds, a kaleidoscopic scene. Individual animals stop occasionally to feed, then hurry on, all going in the same general direction, endlessly pushing on from somewhere to an equally indefinite nowhere.

Wapiti

Cervus canadensis

Many years ago, when the early English colonists first penetrated the forests in America, they found a new deer, a magnificent animal larger than their own "stag" or red deer, but closely resembling it. The Shawnee Indians called it the *wapiti*, but, disregarding the fact that a hump-shouldered, broad-antlered animal of northern Europe already bore the name, the English called it the "elk," and the name has stuck (Plate IV).

Uprooted from practically its entire range, the wapiti have remained only in the Rockies, over a large segment of Saskatchewan and Manitoba and along the Pacific coast of northern California, Oregon, Washington, and British Columbia. Comparatively small numbers have been restored in Pennsylvania, Virginia, Michigan, South Dakota, and New Mexico.

Even in the rugged wilds of the Rockies the white man has encroached on the wapiti's range. Winter is a lean period for most kinds of wild animals; of them all, perhaps the wapiti fare worst. They have been dispossessed of most of their winter range—the valley bottoms and foothill country where the snowfall is light enough for them to reach the cured grasses beneath. Man has settled these places, fenced the fields, and either overstocked the land with cattle or harvested the hay for his own animals. The wapiti are therefore caught between the two millstones of the high mountains, where food is locked in winter's grasp, and the unfriendly, pre-empted valleys.

Many thousands of wapiti have starved to death in recent decades, or have been slaughtered like sheep in natural migration lanes that continue to be used in desperation and necessity. A few attempts to remedy this bad situation have been successful. One of the best known is the winter Elk Refuge of the Biological Survey in Jackson Hole where the southern Yellowstone herd finds food and safety on former farmlands. Other winter range should be provided, however, for the high ranges of the West can support many wapiti at the proper season.

Most polygamous of all American deer, and perhaps of the world, is the wapiti, or "elk." Bugling through the forests during the mating season, he keeps an eye out for additional likely young cows and his ears back for a marauding bull. Of course the strongest and cleverest bull is able to keep the largest harem, sometimes as many as sixty or more cows. The young and old must take what is left. Many a young bull has been seen to hustle his little band of wives off over the hill out of sight at sound of the roar of a mightier bull.

Born in early June, the enterprising little spotted calf begins to follow his mother when he is only three or four days old. One can scarcely believe that some day he will weigh 700 or possibly even 1,000 pounds. Standing about five feet at the shoulders, he will brandish magnificent antlers that may spread a maximum of another five feet. Coated in brownish gray, with dark brown on his legs, head, and maned neck, he will wear a short straw-colored tail over a straw-colored rump patch.

Although he grows up to be a vast-bodied, serious-minded creature, he may still have his lighter moments. Wapiti which are not too old to be overdignified or grumpy have often been seen playing tag and splashing one another in the water. On rare occasions they also indulge in the "circle dance."

Travelers in automobiles have imprudently chased a wapiti on a national park roadway to determine his speed. They have reported a maximum of 35 miles an hour for a short distance. It is fortunate that the animal kept to his heels and did not attempt to charge them.

The larger and darker Roosevelt "elk" (*Cervus canadensis occidentalis*) inhabits the rain forest and northern redwoods belt of the Pacific Northwest, while the much smaller, paler tule "elk" or wapiti (*Cervus nannodes*) remains only in Kern County, California. Wapiti, however, are not exclusively North American, and other species are found in northeastern and central Asia.

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Painting by Walter A. Weber

WITH A WELL-DIRECTED LUNGE A WAPITI BULL DRIVES BACK A FOE; VICTOR'S PRIZE IS THE HAREM OF SPECTATOR COWS

"Elk" is the common, although strictly incorrect, name for this big deer, whose martial bugling still rings in western mountains. Yellowstone National Park and the Jackson Hole country in Wyoming support today over 30,000 **Wapiti,** while the total population of this race is probably more than 165,000. Restocking has brought back the American elk in small herds to several eastern regions.

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Painting by Walter A. Weber

"I'M BOSS HERE. STAY AWAY!" A BUCK MULE DEER (CENTER) DISTRUSTFULLY CONFRONTS A BLACKTAIL (LEFT)

A tail all black on the outer side distinguishes the **Columbia Blacktail Deer** (with female, extreme left), which occupies the heavily forested strip along the Pacific coast from Alaska to southern California. Larger and with wider-spreading antlers, the more numerous **Mule Deer** (with three does, right) ranges from central Alberta, the Dakotas, and Texas to the Pacific. From behind, it shows a whitish patch. The white tail has a black tip.

Mule Deer

Odocoileus hemionus

With large ears scarcely more reminiscent of a mule than his blacktail cousin, the mule deer is distinguished by a white tail with a black tip (Plate V). Although he has two coats a year, it is said that the hairs of his tail last twelve months and the black tip never wears out. Carrying this extremity drooped, he swings it back and forth over the white patch on his rump (page 473).

His habit of bounding into the air like the blacktail and landing on all four feet when running at high speed has given him the colloquial name in Manitoba of "jumping deer." Because of his ears and gait he is also, and more commonly, called the "burro deer."

He has a light-gray face with black on the forehead, and his coat is rusty yellowish red in summer, a warm brownish gray in winter. His legs and underparts are an unchanging gray. Standing 3½ feet high, he averages a weight of 150 to 200 pounds, but on rare occasions has been known to weigh more than 400.

The tines of the buck deer's antlers are typically branching, and the mature to old males frequently carry freak antlers that may have more than 50 "points." These monstrosities, however, lack the beautiful symmetry of more ordinary antlers. Antlered does occur abnormally from time to time, as in other species, but these are rare individuals, seldom capable of bearing young.

West of the one-hundredth meridian, and from the northern Canadian forests to the Tropic of Cancer in Mexico is the home of the mule deer. They avoid deep forests, for the real habitat is partly open, partly wooded. Originally they were said to be numerous on the open plains far from cover, until man took all but the rough country for his own use. As a group, however, the mule deer are versatile, for they are found from the burning deserts of the southwest to the humid, cold mountains of the north.

Most of their territory is mountainous and in winter the snow becomes too deep for them at high elevations. Therefore mule deer are usually migratory, moving to the low country when cold weather arrives. Considerable numbers congregate at this time, and the fawns, although now in their somber gray grown-up dress, chase one another in play.

With the spring breakup the deer scatter, moving singly or in little groups back toward the summer range. Like most polygamous males, at least in the deer classification, the mule deer bucks desert the does until the next fall. At this time the deer especially crave salt, and the licks are well patronized. Perhaps this urge is akin to our own desire for greens after a long winter, and is the result of deprivation of certain minerals.

Their menus are greatly varied. During the winter of the north, they must paw through the snow for mosses and lichens and reach for twigs and evergreen foliage from the trees. In the far southwest where there is little water they often get their moisture from the cactus. Although dead deer have been found with spines penetrating their stomach linings, they usually manage to avoid (or perhaps digest!) the prickly needles.

Like most gregarious deer, the bucks meekly spend the winter in the herd, often led by a wise old doe. In times of flight they may get ahead because they can run faster, but the rest of the time they depend upon her to find refuge, shelter, food, water, and the best licks.

Only half as large as a trumpeter swan's nest, the mule deer's beds are but imprints on the ground (four feet long), sheltered from the winds and with a good lookout.

The doe hides her one or two and very rarely three fawns in various places, always returning to nurse them morning and night. Their spotted red coats are similar to those of the whitetail, but duller and paler. When a human invader appears, the mother stamps her front feet in anger, and her rump bristles. Sometimes she will attempt to lead the intruder away by whistling and circling.

Columbia Blacktail Deer

Odocoileus columbianus

Along the Pacific coast of North America, from Sitka, Alaska, to San Diego is a close relative of the mule deer—the blacktail (Plate V). Except in California, where he spreads eastward over the Sierras, his range is like a shoestring, 2,000 miles in length and hardly 150 miles in width—probably the most oddly restricted of deer ranges. His aptitude for the moist forested country has apparently unfitted the blacktail for life in the arid plains, for he does not venture eastward beyond the rain belt.

Smaller than the mule deer, this blacktail buck of the coast seldom weighs more than 150 pounds. As in the former, the typical tines are forked, but only seldom do all the tines of a set of antlers divide. The two animals may be easily distinguished by the color of their tails. The blacktail's is black, faced with white underneath, and the mule deer's tail is white with a black tip. Not prominent in ordinary flight, the tails of both deer wave rapidly in little circles over their white rump patches when the animals are wounded (page 473).

In October the blacktails are fat from an acorn diet and ready for winter in their thick coats of brown hair finely sprinkled with blackish. The bucks, which have led an aloof and bachelor existence all summer, are resplendent and proud of their polished antlers. Throughout the November courtship season, their necks are swollen to almost twice normal size as they roam the woods looking for mates.

By December and severe winter weather, the deer are run-down in flesh and in poor con-

dition to meet the period of food scarcity, the hungry wolves, cougars, and lynx. With winter's breaking they scatter to higher pastures released from the barriers of deep snow. They nibble the first shoots of the skunk cabbage and eagerly feed on the sprouting browse of oak, hazel, chaparral, ceanothus, seaweed if necessary, an occasional seasoning of toadstools and other fungi. Rapidly they put on new weight.

Although springs and creeks are frequent, the succulence of their browse makes it unnecessary for them to drink for days at a time. The battered and sometimes broken pairs of antlers, which warded off so many blows of last fall and were dropped in the winter, are being replaced. In April the new pair are only fuzzy knobs, but will be fully grown, though still in the velvet, by July.

In May or June the blacktail doe establishes her nursery with one, two, and sometimes three dappled red fawns. In the wooded home their spots may be mistaken for flecks of sunlight shining on the forest floor, and, when danger threatens, the fawns lie flattened and as still as the ground itself. The mother comes to nurse them several times a day until, a month or six weeks after birth, they are able to travel with her.

Virginia, or Whitetail, Deer

Odocoileus virginianus

Proudly flying at full mast or ducked and dragging between their legs, the white tails of these graceful animals are governed by their emotions (Plate VI). Waving madly in fear, flapping ecstatically in mating season, slapped down flat and quivering with pain, they tell the story more poignantly than whistles of alarm and snorts of anger.

The most vivid impression of any encounter with one of these graceful creatures is the waving white flag bobbing away into the forest. As the tail erects, the long hairs rise and spread, so that the total effect is that of a shining feathery banner (page 473).

Ahead of the tail goes a reddish-tan animal (if the season is summer), white muzzle, chin, throat, and underparts. A good look discloses the sleek shining coat, "trained-down" muscles, slender legs, small tapering black hoofs, alert, slim face, and large melting brown eyes. In winter the red coat is replaced by gray, or "blue" as the hunters call it.

Whitetails are found haunting woods and forest borders, from the northern limit of the Canadian forests south to Peru and Bolivia. Generalizing, one may say that the size decreases as one goes southward. The northern deer may stand 40 inches high at the shoulders and weigh 300 pounds, although giant bucks of 400 pounds have been recorded. Several varieties in Mexico scale less than 40 pounds.

More frequently fed than many deer babies, these one, two, or three polka-dotted fawns are nursed by their mothers a half dozen times a day. Not until September are they completely weaned and given new coats without spots. During the rutting season (October and November) the does are too busy to look after them, but with the advent of real winter they again keep an eye on the youngsters.

During the deep snows the deer congregate in cedar swamps. By force of numbers and constant moving about they keep trails broken, forming what is called a "yard." However, available food, the hardwood or cedar browse within reaching distance, sometimes runs short. Nature imposes a strict and brutal population limit on her deer children by allowing the "excess" to starve to death, and it is in winter that the northern deer feel the pinch.

During the summer there is ample room and food. This is the time of plenty, when the doe and her May-born twins or triplets move about in the morning or evening, daintily sampling the most delectable foliage, exploring the shallow waters of ponds and streams for water plants, and looking for windy hilltops where the obnoxious flies will not trouble them. This too is the time when the buck, in the quiet seclusion of some aspen grove, is contemplatively chewing his cud while his antlers grow and harden for use against rivals in the coming fall.

Whitetails love to swim, perhaps as fast as four miles an hour for a short interval; and at times they lie in the water for hours seeking refuge from mosquitoes, black flies, and deer flies. On land they can travel about 25 miles an hour for three or four miles. An occasional leap carries them over brush or gives them a better view of the terrain.

Reaching the prime of life in seven years, they begin to fail at the ripe old age of 10. They do not experience senility, for disease, starvation, a predator, or man dispatches them at some time within the next five years.

If given certain essentials of home, food, and protection from overhunting, the whitetail as a species has remarkable ability to survive and even prosper under adverse conditions. Theoretically, two dozen does will have more than 3,000 descendants in ten years.

In the northern United States the whitetails have gone through a cycle of extreme scarcity because of unreasoning slaughter, but have become numerous or even too abundant when conservation measures were applied. Some of our most populous States have large numbers of this species.

During the 15-day hunting season of 1937 in Pennsylvania, 25,000 bucks were bagged, probably more than the annual increase being killed. Even more amazing are the figures of 1935, when the surplus deer population made it necessary to declare open season on both does and bucks. Hunters carried home 23,802 bucks and 46,000 does!

WITH LONG BOUNDS, A WHITETAIL BUCK AND DOE FLEE FROM PURSUING WOLVES

They wear their brownish-gray winter coats. When excited, the still-abundant **Virginia,** or **Whitetail, Deer** raises its tail, whose white underside is the "flag" that flashes and bobs as its owner runs.

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"STOP, LOOK, AND LISTEN, MY CHILDREN, IF YOU WANT TO LIVE AND LEARN!"

A **Whitetail** doe in rusty-red summer dress and her two fawns freeze in mid-stride. Perhaps it is the youngsters' first sight of a muskrat on a fallen log.

RABBITLIKE DEER HAVE LARGE EYES, ARCHED BACKS, AND SHORT TAILS

At extreme left is a **Red Brocket;** beside him stands a **Brown Brocket.** Both are small deer of Central and South America. The tiny **Chilean Pudu,** running, is the smallest true deer.

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THE PERUVIAN HUEMUL LIVES HIGH

It roams the upper slopes of the Andes. The Chilean Huemul, a southern relative, is a somewhat larger and browner animal, with straighter and heavier antler tines.

Brown Brocket

Mazama simplicicornis

With very short tails, arched backs, and simple, unbranched spike antlers, these small deer of the New World are named by a term originally applied to young European red deer stags (Plate VII). They are distributed over most of tropical and subtropical America, from Vera Cruz, Mexico, south to Paraguay, and in altitude from sea level to 16,000 feet. The zoologist divides these deer into two groups, brown and red.

There are a number of species and races of brown brockets, the color varying in the different forms from dull brown in Paraguay and southern Brazil to a yellowish gray-brown in the Guianas, Venezuela, and northern Colombia. No member of the genus inhabits the Andes north of Peru.

Only 19 inches high, the "simple horn" brown brocket is comparatively light and slender. Individuals deviate in color from brown with a pepper-and-salt finish to gray or whitish. The spike antlers are dirty white, and the longest pair known, according to Lydekker, measures but 5⅛ inches. This small creature is found in the Guianas, Colombia, Bolivia, Brazil, and Trinidad.

Wary and difficult to approach, "simple horn" does not live in the thick coastal forest but inhabits the open *campos* or grassland with occasional stunted trees and open forest. Agriculturists in Trinidad are said to dislike him and his brothers, which are abundant on the borders of cocoa and nutmeg plantations and cause much damage by browsing on the tender shoots and young trees. Brazilian natives call this little deer the *vira* or *veado catingueiro*. The mother brocket produces two white-spotted fawns annually.

Red Brocket

Mazama americana

Red brockets are distributed over much the same geographical range as their brown cousins, from tropical Mexico to Paraguay and Bolivia (Plate VII). In their habitat requirements they are, however, somewhat at variance, for they prefer the dense jungle to the open *campos*, where they occur sparingly. They range in color from dark chestnut red to a distinctly yellowish red, with the middle of the back, the head, and neck varying from black to dark brown.

The typical red brocket (*Mazama americana*) is larger and heavier than the brown brocket (*Mazama simplicicornis*), measuring 27 inches high at the shoulder. At a distance his coat appears to be a uniform glistening brownish red, darkening to black on the back, head, and neck. Close up, however, the sides have a grayish tinge, the throat and inner sides of the thighs are grayish white, and the tail has a brownish cast above with white underneath and at the tip. In Brazil, where he is found quite generally as well as in the Guianas and Paraguay, the red brocket is called *veado pardo* or *veado mateiro*.

At sunset the solitary brocket leaves his "form" or bed in a thicket to feed or browse. The neighboring plantations are particularly popular, for the animal is fond of melons, corn in the milk state, cabbages, and other garden produce. The outraged owners seek retribution by trailing the marauder with dogs. Good hounds are able to run down the brocket in a half hour if the forest is not too dense. Water is a haven of refuge, for it leaves no evidence, but the fugitive is doomed if he cannot reach it quickly.

Different naturalists have observed the red brockets courting at different times of the year. Probably, under the Equator where seasons are poorly defined into "rainy" and "dry," there is no special time for mating. At any rate, the bucks and does afterward go their separate ways, and about six months later the single spotted fawn is born. In three to five days the youngster can follow his mother on her nocturnal excursions. For some time, however, he has little speed or endurance, and, when danger threatens, the mother conceals him in a thick covert and heads for the nearest stream.

Chilean Pudu

Pudu pudu

The Chilean pudu is the smallest deer in the world. A glance at Plate VII will show that he is closely related to the brocket. However, his coat is much coarser and more brittle than his cousin's. Reddish brown, speckled with a paler shade, darkest on the head, it blends into a grayish tinge on the neck.

Standing only 12 or 13 inches high, the Chilean pudu has short legs, diminutive spike-like antlers, and a tail almost too brief to mention. Small-eyed and broad-eared, he wears an odd little tuft of hair that grows in a crest across his forehead and ends around the base of his horns. Living in the Andes of central and southern Chile, he migrates down to the plains during the winter. He usually skulks in dense forests and thick undergrowth.

A related species, two or three inches taller, lives in the mountains of northern Chile, Peru, and Ecuador. He is similarly colored, but has very dark legs and feet and is flecked with bright rufous instead of pale brown.

Peruvian Huemul

Hippocamelus antisensis

In the Andes of Peru, Ecuador, Bolivia, and northern Chile, living at elevations of from 11,000 to 16,000 feet, is a gray, rather stout, heavy-bodied deer. The Indians call him *huemul* or *guemal* (Plate VII). His short, bushy tail is partly bordered by black, his throat is smartly white, and his long ears are

sharply pointed. Rising from the buck's head is a characteristic pair of weak, two-tined antlers, forming a single fork which is curiously close to the base. Somewhat smaller than an average North American whitetail, he stands about 34 inches high.

Like other deer whose homes are located on the Equator, the Peruvian huemul knows only the dry and rainy seasons. Since there is too little change of temperature to cause a winter and summer, he is not a migratory animal like his close cousin, the huemul of Chile. Instead of being driven from high forests down to the open valleys and back again, he stays comfortably at home year after year.

The Chilean huemul *(Hippocamelus bisulcus)* is five or six inches taller and distinctly brown in color. His face is strikingly marked by a broad black line running from the muzzle to a point between the eyes, where it divides like a Y. Large exposed glands lie conspicuously below his eyes. The antlers are heavier than those of the Peruvian deer and the two tines fork about two inches above the base instead of next to the head. Both sexes possess canine teeth in the upper jaw, but these incipient weapons do not project beyond the lips.

The Chilean species is most abundant at the extreme southern end of the continent, although its range extends north to central Chile. In summer it lives in the dense forests of the Andean valleys, but winter snows induce its annual migration to the foothills and neighboring plains.

South American Marsh Deer

Blastocerus dichotomus

Although Nature did not neglect the South American Continent when she was distributing deer, she gave all the large species but one to other parts of the world. This single exception is the swamp deer, which is found throughout Brazil, part of the Guianas, south through Paraguay and Uruguay to the Chaco of interior Argentina (Plate VIII).

In summer his coat is a bright chestnut red, which changes in winter to a brownish tone, becoming paler on the flanks, chest, and neck. The lower half of the legs is black, and the under throat and inner side of the ears are white. As large as the red deer of Europe (48 inches high), the buck carries a fine set of antlers with tines which fork something like those of the North American mule deer.

When they are disturbed by enemies, the marsh deer remain hidden in the jungle along rivers or in palm "islands" during the day. They have been well named, however, for their normal habitat is marshland. Some authorities say that they are gregarious and travel in bands of three to five animals. Of course the does stay with their fawns, but Miller found the bucks in Matto Grosso living alone except during the mating season.

Hunting, unfortunately, is all too common. Thousands are shot for their hides alone, although the return hardly reimburses the natives for the ammunition expended. The hunters consider the flesh of the *veado galheiro grande* or *guazupuco* as almost unfit to eat unless other food cannot be obtained. Against natural enemies the marsh deer can hold their own, for their rocking run, while appearing laborious, is effective in the soft, swampy ground of their native home.

Pampas Deer

Blastocerus bezoarticus

The mother pampas deer shows the greatest solicitude for her lighter-colored fawn (Plate VIII). When danger appears, she first stands guard while her child hides himself. Then she attempts to decoy the invader by running off in the opposite direction. If she fears that he will not be sufficiently impressed, she pretends to be wounded by limping ostentatiously.

The characteristic odor of the pampas deer, which is penetrating and disagreeable to human nostrils, is said to be perceptible nearly a mile away. This powerful scent is exuded from a sac located between the phalanges or toes of the hind feet. Hunters can tell when an animal has been startled or routed from his bed, for in such instances the stench is particularly noticeable. Normally, it probably serves as a means of communicating certain information among the deer themselves.

As the name implies, the pampas deer are found on the prairies of the Argentine. Their range extends north, however, over the *campos*, or tree-dotted grassy savannas, of Uruguay, Brazil, and Paraguay into the forested section of the Argentine Chaco.

The open pampas were originally dotted with clumps of tall grass which furnished some shelter and concealment. Although this growth has been eliminated by cattle grazing, the wary deer are able to persist. They run swiftly and gracefully, easily leaping over an occasional bush or other obstruction. Even in flight on the open plains they continue to jump into the air, perhaps either as a habit inherited from their bounding ancestors or to obtain a better view of approaching danger.

When startled, they whistle a low sharp cry of alarm. Because they are especially fond of succulent green grass, their favorite haunts are the burns where new grass is coming up. The native cowboys (gauchos) sometimes test the speed of the best horses by running down the pampas deer armed with *bolas* or lassos.

In Matto Grosso the three-pointed antlers are shed during May and new ones begin to grow immediately. At this time the deer are generally solitary. By September the rapidly grown horns are mature and free of velvet, and the bucks and does collect in bands of a dozen or more individuals. Old males, however, may remain apart in grumpy solitude.

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Painting by Walter A. Weber

A RAGING GRASS FIRE ROUTS DEER AND DUCKS FROM A SOUTH AMERICAN SAVANNA

Splendid many-tined antlers crown the large buck **Marsh Deer** (left, with two does). He and his kind frequent marshes and riverside jungles in Brazil and northern Argentina. Much smaller is the **Pampas Deer** (right), which lives on the dry, grassy plains and travels in herds. Expert gauchos sometimes capture these swift creatures with their lassos or weighted bolas.

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GIANT OF THE PLAINS, THE HAUGHTY BARASINGHA

Individuals sometimes weigh a quarter of a ton. The species is native to peninsular India. Herds of several hundred may travel together, breaking up only at fawning time.

Paintings by Walter A. Weber

"MISSING FROM OLD HAUNTS: PLEASE NOTIFY IF FOUND"

Schomburgk's Deer, of southeastern Asia, has not been reported from its native habitat in recent years. A few are wards of civilization in zoos. Magnificent antlers may show as many as 20 points.

Photograph by Courtland DuRand

PROUDLY A TEAM OF TRAINED ELK PULLS A WAGON ACROSS A NARROW DAM

On his ranch for big game in Montana, Mr. Courtland DuRand raises and protects herds of wapiti, buffalo, antelope, and deer. After weeks of tireless handling, he broke a pair of elk to harness and taught four others to carry packsaddles. Mr. DuRand has also schooled his animals to dive into a lake from a 40-foot tower.

Barasingha

Cervus duvauceli

The large, heavy barasingha or swamp deer is found in the Central and United Provinces of India and, eastward, in parts of Assam (Plate IX). It is considerably larger than our own mule deer, for a good stag stands 54 inches high at the shoulders and weighs 400 pounds. An exceptional fat animal may scale up to 560 pounds.

The fine, smooth, and rather thick coat is yellowish brown in winter, changing for the summer to a light rufous brown, usually spotted with white, especially along the darker back. The doe is modestly paler than her lord and master, who regally tosses antlers rising fully 40 inches from his forehead. The smooth horns are unique. Above the brow tine the beam is unbranched for more than half its total length before sending off the usually precise number of 11 tines. This has given rise to the Indian name *barasingha,* which, translated, means "12-tined deer."

Except in the northern portion of its range, "swamp deer" seems a misnomer, for elsewhere the barasingha is confined to tracts of sal forest. His habitat and range, incidentally, correspond with those of the red jungle cock, the ancestor of our domestic poultry. Preferring to graze rather than to browse, the swamp deer frequents the outskirts of woods or grassy plains dotted with trees—never thick jungle. Although he rests in the middle of the day, night is not so exclusively feeding time as it is for a number of other kinds of deer.

In northern India the swamp deer lives up to its name, for here it inhabits marshland and is seldom out of water. In places in this type of country, a few miles of swamp may be home for thousands of the animals.

With the beginning of the winter season, the swamp deer collect in bands of 30 to 50 or even several hundred animals. Mating commences late in October or the first of November. The eerie, penetrating roars of the males are thrilling and impressive.

Each stag acquires a harem that may number as many as 30 does. By January or February the lordly antlers have served their function of display, offense and defense, and are shed. The bucks, however, are not long crownless, and new antlers are already in the velvet at the end of March. The single spotted fawn is born in the spring.

Schomburgk's Deer

Cervus schomburgki

One of the rarest of all the deer tribe, Schomburgk's deer may now be extinct, except in zoological parks (Plate IX). There are no records of its habits in a wild state, and probably, like the milu (Père David's deer), it exists only as a ward of civilization. In 1937, while visiting Siam (Thailand), where the species was formerly confined, Dr. Harold J. Coolidge, Jr., of the Museum of Comparative Zoology at Harvard University, was unable to get any report of a continued existence in its range, the northern districts of that country.

About 41 inches high at the shoulders, Schomburgk's deer is slightly larger than the average whitetail deer. The uniform brown color of his long, coarse winter coat is lightest on cheeks and flanks. Underparts and lower lip are whitish, and there is a distinct reddish tinge on the upper lips, on the back of the head, and on the legs. As can be seen in Mr. Weber's painting, the antlers are large and complex. Above the long, heavy brow tine the beam is very short before branching into two equal-sized forks, which in turn branch again into pairs of tines.

Sambar

Cervus unicolor

Animals living in the Tropics where the seasons are not clearly delimited frequently acquire unusual customs. Conventional bucks drop their horns and renew them annually, but the sambar is eccentric (Plate X). Built perhaps of sterner stuff, his powerful antlers give him lusty service for three or four years.

Possibly because he is so large (600 and even 700 pounds in weight), the sambar is sometimes called "elk" by Indian sportsmen. Somewhat resembling the American "elk," or wapiti, in size and form, he also wears a light patch on the buttocks. His general color, however, is dark brown, and his antlers are more massive with only *three* heavy tines.

Greatest of all sambars, the Indian species stands 54 to 64 inches high at the shoulders. Others nearly as large extend eastward across Ceylon, Burma, the Malay Peninsula, Siam (Thailand), and southern China, and also occupy Borneo, Hainan, Formosa (Taiwan), and the Philippines. Sambars prefer rolling or hilly country and live in the Himalayas as high as 9,000 or 10,000 feet above sea level. Much of this range is also occupied by tigers, and many deer fall prey to them.

Although sometimes found living alone, the sambars are generally encountered in small bands of 4 to 12. Resting in dense woods of the higher hills during the day, they move down to grassy openings to feed at night. They often commandeer the hospitality of sugar cane plantations, but they are also fond of other leaves and shoots, grass, vegetables, and wild fruits, especially ripe mangoes. Because of their fruit diet, it is claimed that they can go without water for several days.

"FOUR EYES" TO THE CHINESE

During the rut, which takes place in November and December, the sambar buck walks stiffly, with tail outstretched. His face glands evert widely, giving out a strong smelling secretion, and his eyes roll until the bloodshot sockets are exposed. Because of the open glands below his eyes, he is called "four eyes" by the Chinese. Morning and evening, and on into the night, he bellows, a loud, somewhat metallic roar quite distinct from the alarm note—a sharp short "ponk." The amorous doe, attracted by the sound and by the scent of the face glands, responds with a faint, grunting low.

The only other sound emitted by these deer is a hissing snort given when they are alarmed. This is often accompanied by the stamping of a foot.

FAWNS NEVER SPOTTED

The sambar mother gives birth to one or sometimes two fawns in late May or early June, at the commencement of the rains. Unlike other fawns, these chocolate-colored youngsters are never spotted.

Sambars are sought for both food and medicine. The meat is coarse and dry, but palatable. Their antlers are believed by many Chinese to have great therapeutic value when taken in the pulpy velvet state. These magnificent animals are difficult to hunt, for they are very wary and, merging into the shaded jungle background, are almost impossible for the hunter's eye to distinguish. Although extremely active and agile in the jungle, they are not particularly speedy and in the open can be run down by a good horse. Since the time of the Greeks, they have been known to thrive in captivity and today are bred in many zoological parks.

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Painting by Walter A. Weber

TOSSING HIS MASSIVE ANTLERS IN VAIN, AN AMBUSHED SAMBAR RECOILS FROM A TIGER'S SUDDEN ATTACK

To avoid the menace of the deer's deadly sharp tines and slashing forelegs, the roaring cat has attacked from behind. Two does bolt away. A stocky animal, the **Sambar** of southern Asia may stand as much as four and a half feet tall at the shoulder. Usually it moves in parties of four to twelve, hiding in thick cover during the day and feeding at night in glades or even in sugar-cane plantations.

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Painting by Walter A. Weber

IN SHADY ENGLISH PARKS, DEER LEAD A HALF-DOMESTICATED LIFE

One of the commonest is the **Fallow Deer** (animals to left of tree). Originating in Mediterranean countries, it was probably first introduced to the British Isles by the Romans. The spotted stag, with handsome palmated antlers, and doe (left foreground) show the normal summer coat. Other color phases occur; for example, the dark form (extreme left) and the white (center background). At the right, a **Roe Deer** pauses with two does. Roe stags pursue the females in circles, wearing "roe rings" in the ground. The European race of this species ranges over central and southern Europe.

Fallow Deer

Cervus dama

The ancient Romans are supposedly responsible for introducing the fallow deer to England (Plate XI). The animals have never been "wild" there, but have been kept under fence for almost 20 centuries. For the last four or five hundred years, the species has been an essential living ornament of every wealthy nobleman's estate.

Standing about three feet high, the fallow deer elegantly display their antlers, which flatten or palmate like those of the moose, but usually only to a width of three or four inches, and rarely as much as eight inches. From May to October, the deer of the normal species are clad in dainty yellowish-brown coats dappled with white spots on the back and flanks. In winter they change to dark brown trimmed with dun on legs and belly.

Spectacular white and black phases of the fallow deer, not spotted, are valued highly for ornamental purposes.

Little is recorded of the habits of this deer in the wild, nearly all the literature relating to park animals. Does and young are very gregarious and stay in large herds. Through the rutting season and early winter they are joined by the bucks. The young, born in June, are usually single, but occasionally twins occur.

Fallow deer like the leaves and twigs of most deciduous trees, but the majority of their subsistence comes from grass and other herbs. When horse chestnuts are ripe, they consume large quantities of the bitter nuts. During the winter, in northern Europe, they must be fed hay and corn, for natural food in the overgrazed parks is not sufficiently nutritive for these natives of warmer lands. At this season they feed throughout the day. In summer, on the other hand, they usually move about in the evening and early morning. In the damp, cool English climate the infrequent sun is welcomed, and on hot days the deer lie stretched out in the forest openings, absorbing the ultraviolet rays. When startled, they jump up with a grunting "bark."

Several varieties have been developed in captivity. Stature, and especially antlers, have in some cases suffered marked deterioration from inbreeding. In spite of centuries of confinement, the race is still essentially wild, and at times the bucks attack humans with too frequently fatal results. They are all the more dangerous because they appear friendly and gentle. On a recent visit to Germany, Dr. Carl P. Russell was nearly knocked over by one of these deer just as he was about to board a streetcar in the suburbs of Berlin. The deer meant no harm at this time, but was hastily escaping a pack of dogs.

Fallow deer are native to southern Europe—Portugal to Greece, parts of Asia Minor, northwestern Africa, and the Mediterranean islands of Rhodes and Sardinia. They are also kept in a semidomesticated state in southern Sweden, in Italy, and in Tasmania as well as in Britain. A related race, larger and more brightly colored, is found in the mountains of Iran (Persia).

Roe Deer

Capreolus capreolus

In contrast to all other deer, the roe buck is frequently monogamous (Plate XI). Although it is not usually necessary to fight for his wife each summer, he indulges in occasional vigorous disputes with his fellow bucks. Faithfully he stays at home month after month, but is driven out in the fawning season of May and June.

During this period of exile he is apt to journey far and wide. He then begins a new life with another doe or returns to his stay-at-home wife in time for the mating season and to help raise the children. Unlike most deer fathers, he not only is likely to know his own sons but is supposed to be as energetic as the doe in defending them.

The spotted fawns born in May are generally twins, occasionally triplets, and sometimes only a single youngster. The mother hides her offspring in dense undergrowth for about ten days until they are strong enough to move about with her.

These slender, rather small deer, with two or three-tined antlers rising very close together and almost vertically above the bucks' heads, stand about 26 inches at the shoulders and average 40 pounds in weight. Their new thin coats, almost as red as the traditional hunting garments, slowly fade with the wear and sun of summer and are shed in autumn for the thicker and coarser winter attire of dark speckled brown with a large white rump patch. As in a few other deer, the hairs of this patch rise and fall according to the state of the owner's emotions. Albinos occur among the roes, as in many species, and have been reported in Scotland and Germany. The winter-grown horns are peculiar in lacking a brow tine and are normally only 8 to 11 inches long, but may attain a maximum of 15.

Although the males of most deer become sexually active soon after the antlers are mature and completely cleaned of velvet, roe bucks are not so eager to mate. The velvet is rubbed from the horns by the end of February, but their rut does not occur until July and August. At this time the males pursue the females in circles. These "rings" are used by the roe deer the rest of the year for exercise and diversion. Sometimes a lone deer will practice running around by himself. At other times as many as ten will engage in this pastime together.

Roe deer feed on grass and some browse. They are particularly fond of rowan berries

and often dig up fungi in the fall as a special treat.

When startled, they bleat harshly. With heads carried high, the animals dash off in a series of long, bounding leaps which generally subside to a trot. They make up for lack of speed by being adept at crossing and confusing the trail. They take readily to water, presenting a difficult problem for pursuing dogs. This species has always been a favorite object of the chase and is considered better venison than the red deer.

Quite unlike the sociable fallow deer, the roes do not congregate in herds. Generally only pairs or family groups are found together, haunting the dense undergrowth of broken high country forest, never thick forest or open plains.

Roe deer of several recognized varieties are found from England and Scotland, east across Europe and Asia (north of the Himalayas) to the Pacific. The best-known variety is seen in Britain, southern Sweden, Spain, and east to Asia Minor and northern Palestine.

Japanese Sika Deer

Cervus sika

Divided by zoologists into five races, the sika deer inhabit far-eastern Asia: Japan, northern China, Manchuria, and Formosa (Plate XII). With the exception of the large mandarin sika of China and Manchuria, which stands an impressive 48 inches at the shoulder, the sikas are not large. The Japanese form is 32 to 34 inches high and weighs 170 to 180 pounds, corresponding to a small whitetail of the United States.

The sika of Japan is a plain smoky brown in winter, changing with spring to a beautiful chestnut red spotted with white. The hairs of his white rump, edged with black, erect at the first sign of danger, warning his companions and subsiding only when his mind is at rest again.

Although Japanese scientists have studied this deer in his native home, their work has not been translated into European languages. We know little about the animal's natural way of life, except that he inhabits the darkest forests, preferably in hilly country.

In captivity this dainty, appealing deer is very popular with the Japanese. Family groups, when going to the country on outings, frequently take along little rice cakes to feed the park deer, just as Americans bring peanuts to the zoos to feed the bears.

The Japanese sika have been imported to Europe and New Zealand, where they have also been semidomesticated. In England they find conditions suitable and breed well. Resembling the red deer in habits, they have mated with this larger relative in zoos. During the rutting season the bucks give vent to their emotions by whistling, the sound sometimes passing into a scream. The doe produces only one fawn at a birth.

Axis Deer, or Chital

Cervus axis

The jungles of the alluvial plains and hills of India and Ceylon have produced one of the most beautiful of all deer, the axis deer, or chital (Plate XII). The native name *chital* (spotted) refers to his most noticeable characteristic, the decorative white spots which he wears throughout the year. These are so numerous on the bright reddish-fawn background that they sometimes form lines on the lower flanks.

A further mark of distinction is the handsome dark stripe which runs from the back of the head to the end of the tail. About the size of an average whitetail of our own country, the chital weighs from 150 to 180 pounds and stands approximately 36 inches at the shoulders. The outside curve of his imposing antlers measures about 39 inches.

The axis deer enjoy companionship of their own kind and congregate in herds sometimes numbering hundreds. Their friendliness even extends to other forest animals, particularly to monkeys, with whom they are often found. Water is an essential to these deer, for they must drink regularly. By the Indian sportsman they are always associated with grass-covered forest glades and heavily shaded streams. If good cover is available, hills or plains are all the same to them, and even human activities and dwellings are disregarded. Perhaps some of their self-confidence arises from knowledge that, in sun-flecked jungle, they are almost invisible, the spotted coats achieving this magic result.

After lying concealed during the day, the axis deer come out at evening to feed on tree shoots and grass. An alarm is given by a loud scream and immediately the whole herd disperses with long flying leaps. They swim easily and often take to water for ordinary travel as well as to escape enemies. The mother axis deer has only one fawn at a birth, which may occur at any time of the year but more usually during the cold season.

Such graceful, beautifully colored and marked deer as these are sure to be conspicuous and sought after. The Romans prized them for parks and exhibitions, and numbers have been imported to England in the last two centuries for liberation on estates. They have thrived wherever the climate is not too cold. Sometimes, as in New Zealand, they have increased to such numbers as to become a serious menace to crops and forests. For years the national park authorities of that country have hired a "deer exterminator" whose unpleasant duty it is to kill all the animals possible. Otherwise, the parks would be denuded by the rapidly multiplying and hungry deer.

JAPANESE PARK DEER BEG RICE CAKES FROM PICNICKERS

In its natural state, the **Sika,** of Japan and Manchuria, inhabits the deepest forests. It wears indistinct spots in summer and a suit of uniform smoky brown in winter.

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Paintings by Walter A. Weber

FOREST DEPTHS OF INDIA SHELTER BIG HERDS OF THE AXIS DEER

Often called the "Chital," this graceful animal owns a lovely coat of bright reddish fawn. Its abundant spots stay with it at all seasons.

KNIGHTS OF OLD FOUGHT HAND TO HORN WITH STAGS AT BAY

Bouts with the noble **European Red Deer** provided battle training. Reserved for the sport of nobles, these proud creatures were hunted with staghounds.

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Paintings by Walter A. Weber

FEW SPECIMENS REMAIN OF THE MOURNFUL-LOOKING MILU

Also called "Père David's Deer," the **Milu** has a long, mulelike tail and antlers lacking brow tines. This oriental deer is not known in the wild state; a few are kept in parks.

Red Deer

Cervus elaphus

The famous red deer is known to all English-speaking peoples as the stag of literature (Plate XIII). Long before the Norman Conquest, the Saxons regarded the red deer as their most prized game. Throughout western Europe, since the formation of a distinct ruling class and until the French Revolution, this deer was reserved for the sport of the nobility and protected from commoners by rigid laws that carried severe penalties for infringement.

The chase gave the hunter an opportunity to test his courage and horsemanship. When brought to bay, the stag's strong horns were formidable battering rams from the short killing distance imposed by hand weapons. An old English saying expressed the risks of this hazardous sport or training for war in terse words: "Man goes from the boar to the leech, from the hart to the bier."

Red deer, of several races or subspecies, are found in suitable wild places (and of course in parks) throughout most of Europe (England and Scotland included, but Italy excluded), east to the Caucasus and into the Caspian provinces of Iran (Persia). A variety also occurs in northwestern Africa.

The typical European red deer is large, standing four feet in height at the shoulders and weighing a little less than 300 pounds. Record stags, however, have scaled 550 pounds. The reddish-brown summer coat, lighter on the face and underparts, changes to gray in the winter. Both coats have a small, light-colored patch on the buttocks.

These deer often wallow, especially in spring and fall, rolling luxuriously in the mud. This process is supposed to aid in removing their old coats.

Through the summer months the stags feed in the higher hills, perhaps because it is wilder there, but in early September they begin to seek out the hinds, which, with the young, have remained in the valleys. By October the rut is on in earnest. The stags battle furiously, sometimes to the death, for the favor of the females, which watch quietly from a distance and callously go off with the victor.

The rut ends, peace reigns, and a few months later the antlers that have given such active service are dropped. Although cast antlers are eaten by rodents and also by some hoofed animals in captivity, they rarely appeal to the palate of wild deer. In the British Isles, however, both male and female red deer gnaw the stag's horns after they are shed in early spring. Perhaps this satisfies a craving for minerals that are too scarce in the soil and plants.

In May or June the spotted fawns are born, usually singletons, but rarely twins. The mothers conceal the youngsters in heather or bracken, returning frequently to nurse them and never straying far away.

Milu

(Père David's Deer)

Elaphurus davidianus

In 1865 Père David often wondered what went on in the pleasure grounds of the Chinese Son of Heaven. At last he peeped to satisfy his curiosity. Being a naturalist, he was most of all impressed by the sad-eyed deer the like of which he had never seen before (Plate XIII).

Standing nearly four feet tall, they appeared to weigh about 500 pounds. The tawny-brown color was emphasized by dark chests, a ring around the neck, and stripe halfway down the backbone. Their shaggy coats mounted to manes on the neck, the long, heavily haired tails switched uneasily, and the horns, the branching tines of which seemed to make up most of the antlers, stretched 30 inches from their heads. As the good father watched, they looked up with a mournful expression and walked away with a peculiar, slow, stately gait that was accompanied by a loud clicking of the hoofs.

Because they wore long tails like mules, trotted like horses, brayed like donkeys, and had spreading hoofs like cows, the Chinese were not sure that these creatures were deer. They settled the matter by calling the milu *sze-poo-seang,* meaning "like none of the four" (horse, cow, goat, or deer). Since Père David was the first white man known to have seen the milu, his name has been associated with the species in Caucasian literature.

During the Boxer Rebellion a storming party from the attacking European expedition breached the outer walls of the Son of Heaven's palace, and the deer escaped, most of them only to be killed and devoured by the hungry peasantry. A few were recaptured, however, and were taken to England to the Duke of Bedford's estate, Woburn Abbey. Here a herd of about 50 animals is still kept.

They eat grass, rushes, and other water plants. The males' antlers are stripped of velvet in May and early June, and during the following two months the bucks bray like donkeys for new mates. Each doe has one or two spotted, tawny-colored fawns which, like their mother, will soon have the longest tails of all deer species.

No information survives on the habits of Père David's deer in the wild state. Probably originating in northern China and possibly Kashgaria, they are known to have existed in prehistoric Japan. Their large spreading hoofs lead one to suppose that they originally lived in marsh or boggy country.

Musk Deer

Moschus moschiferus

Most important of all deer to women is this quaint little creature which secretes musk for their perfumes (Plate XIV).

For many years zoologists refused to accept this animal as a member of the deer family. Less than two feet high, he scarcely looks like a deer with the ludicrous rump of his stout, heavy body rising two inches above his shoulders. His long hind legs reach out much farther than his front ones. His ears are large, and his tail has started but never finished. Lacking antlers since his world began, he has learned to fight his battles with long saberlike teeth.

Living as he does at an altitude of from 8,000 to 12,000 feet in the Himalayas and on the plateau country to the north, the musk deer must be prepared for severe winters. The thick coat of coarse hair keeps him well insulated during the long daylight hours that he lies concealed in cover. Emerging in the evening, this solitary little animal easily and surefootedly walks across the steep snow-covered mountainside in his search for lichens, grass, roots, and twigs.

His peculiar ability to stick to slippery ledges is due to the wide "false hoofs" (dewclaws), which are even larger than the narrow pointed main hoofs. His toes can spread far apart and are strengthened by stout ligaments.

The musk deer mates in January, and fawning time occurs the following June. Usually there is only one spotted fawn, and the precocious youngster may mate when less than a year old. This is Nature's rule with short-lived animals, and the musk deer has a life expectancy of only about three years.

Once he was abundant in the Himalayas, but demands of 19th-century aromatic fashions made great inroads on his numbers. His habit of stopping to look back at an enemy, after making a few enormous leaps in flight, allows the hunter to get in the fatal shot.

The musk deer is also easily snared by taking advantage of his tendency to follow obstructions. Native trappers construct a low brush fence in which openings are left at intervals of 100 to 150 yards. On the ground in each gap is placed a noose, connected to a springy bent sapling in such a way that an animal stepping into the snare will disengage the sapling and be suddenly lifted into the air by a leg.

The globular musk gland, located in the skin of the middle of the male's abdomen, is removed entire and dried. The contents weigh about an ounce, although this varies with the season of the year and age of the animal.

Indian Muntjac

Muntiacus muntjak

The lonely little Indian muntjac trots through the jungle with a very faint, odd clicking sound (Plate XIV). When excited, he will give a series of loud staccato barks, like a dog, which has given rise to the popular name of "barking deer." His clamor is astonishingly noisy for his half-pint size, but, unless trailed, he will continue yelping until the cause of his agitation has ceased.

Europeans stationed in India and points to the east in southern Asia consider the muntjac a high test of hunting skill. Living in thick jungle, he emerges to the woody borders or clearings only to graze and browse. The novice hunters never see this quarry, for he knows when to be silent. Keeping ahead of the pursuers' noisy, floundering progress in the dense thickets, he moves easily and stealthily with his head much lower than his hindquarters. If unsportsmanlike methods of hunting, such as running with dogs, are not employed, the muntjacs will live long and multiply.

This elusive animal, when finally captured, proves to be an amazing creature. Two dark riblike lines start above his nostrils and run up the face and the front of the extraordinarily long pedicles, or antler stalks. These bony, hair-covered spikes, about four inches long, are topped by brief horns that are usually even shorter than their supports. As if in recompense for these trifling antlers, Nature has given the muntjac an excellent pair of tusks with which he can inflict severe wounds.

The doe has neither tusks nor antlers, and in place of the pedicles she wears tufts of bristly hair which terminate the face lines. These latter rib marks on both sexes, which look like the painted daubings of an American Indian warrior, have conjured up another popular name of "rib-faced deer."

About 20 inches high, the little muntjac weighs scarcely 40 pounds. His ears are oval-pointed and his feet small. He wears a coarse, smooth coat of reddish brown that becomes paler on the belly and white on the hindquarters, chin, and throat.

Although in southern India muntjacs mate at various times of the year, in the northern latitudes most of them prefer January and February as the period for courtship. At that time the bucks become bold. They walk about quickly, lifting their legs in a curiously deliberate fashion. Rivals for the does fight fiercely, using the long upper canine teeth rather than the diminutive horns. At this time they are especially vociferous and persistent in their barking.

After mating, the animals return to their normally solitary ways. About six months later the doe gives birth to one or two spotted fawns. Her very long and extensile tongue is especially adapted for washing the babies and is supposed to be long enough to reach entirely over her own face. When feeding, she uses it to wrap around a twig, stripping off the leaves and pulling them into her mouth.

Muntjacs of other varieties are found outside India, through Burma, the Malay Peninsula, Siam (Thailand), Java, Sumatra, and Borneo. They vary from bright chestnut to tawny.

TO FIGHT OFF AN EAGLE, AN HIMALAYAN DEER DEPENDS ON CANINE TUSKS

The little **Musk Deer** has no antlers. Base for many perfumes is the musk secreted in a sac under the male's abdominal skin. Thick, coarse hair protects it from the cold of high altitudes.

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Paintings by Walter A. Weber

WITH VOICE AND TROT LIKE A DOG'S, HE IS DUBBED "BARKING DEER"

Shy and wary, the small **Indian Muntjac** clings to the cover of dense jungle. The buck (left) has two long upper fangs. Short antlers rise from hair-covered bony stalks.

MICHIE'S TUFTED DEER HIDES STUBBY ANTLERS IN CLUMPS OF HAIR

Closely related to the Muntjac (opposite plate, lower), this alert species makes its home in bamboo groves and reed beds bordering Chinese rivers. The male (left) has protruding canine teeth.

© National Geographic Society

Paintings by Walter A. Weber

WITH CHINESE WATER DEER, A "LITTER" OF FAWNS IS THE RULE

This race is less than two feet tall. From the shelter of reeds and high grass it often takes to the water. Neither sex carries antlers, but the buck is armed with long tusks.

Photograph by Richard H. Stewart

IT LOOKS LIKE LOVE—BUT IT'S ONLY HUNGER

Old Bill, a pet buck mule deer at the Grand Canyon, steals a tempting morsel from between a friend's teeth. His antlers, although almost full-grown, still are sheathed in the protective velvet. The youth is taking a chance, because no adult deer can be trusted.

Michie's Tufted Deer

Elaphodus elaphodus

Laymen often poke fun at specialists for conferring apparently ill-suited names on animals. With the title of the tufted deer, however, no fault can be found (Plate XV). The long black hairs rising from his forehead form the most conspicious feature of this little creature, which is only 22 to 23 inches high. His antlers are mere apologies for weapons. Scarcely more than an inch long, these puny spikes do not even protrude above the crown hair tufts. Fortunately, he has been given long saberlike teeth to help him win his battles.

Although closely related to the Indian muntjacs in general conformation and proportions, the tufted deer are heavier, much shaggier, with wider ears.

Of the two known races, only one, Michie's tufted deer, is illustrated. His coarse body hairs are whitish with brown tips, the resultant effect being a brownish "pepper-and-salt" color, darkest on the legs and center line of the back. The speckling is especially pronounced in front, on the chest, neck, and head. Fawns are much like their parents in color, with the addition along the back of two or four rows of indistinct white spots which disappear as they grow older.

Michie's deer range over central and southern China. Always associated with water, they are abundant in the reeds bordering the rivers.

The other race, the Tibetan tufted deer, is quite similar to Michie's, except that the animals are darker and are speckled only in front of the shoulders. They are limited in distribution to eastern Tibet, one of the least-known areas on the globe, and there is no information about their life history or habits.

Chinese Water Deer

Hydropotes inermis

Relatively defenseless animals generally have large and frequent litters of young, for only in this way can a high mortality rate be offset and perpetuation of the species be assured. Thus rabbits and mice have as many as a half-dozen litters in a season, of eight or more babies at each birth.

Deer were once in similar need of a high birth rate, for they were small creatures, hardly larger than cats, and continually preyed upon by their carnivorous superiors. As they developed size, speed, and senses to detect danger, the rate of survival increased. Large families then became a handicap because many hungry mouths made a scarcity of food. Their evolution brought a change in birth rate. Today most members of the deer tribe have usually one fawn at a birth, and rarely more than twins.

Photograph courtesy U. S. Department of the Interior

GREEN LEAVES AU NATUREL ARE A FAVORITE FOOD WITH THE MULE DEER

In California's Sequoia National Park a doe half-climbs a manzanita bush to browse upon its foliage. Mosses, lichens, twigs, and grass round out the menu of this species.

The Chinese water deer is regarded as an ancient type, for, less than two feet high, the mother produces from three to as many as six or even more fawns at a time (Plate XV). The youngsters are faintly spotted with white in lines running "fore and aft" from the neck to the tail. The parents have a coarse, hard pelage, light rufous chestnut in color, stippled with blackish; and the underparts, throat, chin, and sides of muzzle, are white.

Neither parent has antlers (another sign of antiquity of the species), but both have formidable tusks for defence of themselves and family. The buck's canines are somewhat larger than his mate's and are slightly convergent. The species is found only in northeastern China and Chosen (Korea).

These water deer are well named, for they live in the reeds bordering rivers and lakes, where they feed on grasses and sedges. Rather sociable, they are found in small groups of two or three adults with their numerous progeny. The hardy hunter who tries to find them in this thick cover may set them to flight in quick, short leaps much like those of a hare. After running for a short distance, they suddenly drop again into the rushes.

Rusa

Cervus hippelaphus

Rusa, the Malayan word for deer, is applied to this handsome creature of Java, Borneo, and the Moluccan Islands (Plate XVI). On those fragments of land that splatter the South Sea east to New Guinea, we find a similar but smaller deer. The more formal systematists believe that they are a related, though separate race from the Javan animal. Other zoologists, however, remind us that the Malayans have loved animals from time immemorial and have caught, tamed, and taken them on sea voyages from island to island in their big canoes.

In this way the island deer may be descendants, many times removed, of the rusa of Java. At any rate, they lack the impressive mane so well developed on the throat and neck of the Javanese male rusa, are not so "rangy" in form, and carry smaller antlers.

About four feet high at the shoulder, the size of a red deer, the rusa in summer is a dark, grizzled ochraceous brown with a tinge of red, darker on the hindquarters. In winter the coat becomes more grayish.

The antlers are rather slender for such a large animal and closely follow the same regular form even though many heads are compared. They are all three-tined, the pair enclosing a lyre-shaped space.

Little is recorded of the habits of these deer. In Borneo they are hunted with dogs, driven into a ring formed by native hunters, and killed with spears. The meat is then smoked and brought into the villages.

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Painting by Walter A. Weber

JUNGLE FOWL WHIR AWAY AS A FLEEING RUSA STAG GALLOPS PAST

Hunters and dogs have started a big **Rusa,** named from the Malayan word for deer. Many races of this deer dwell throughout southeastern Asia and Netherlands Indies. They vary in size and shading, but all carry graceful three-tined antlers and usually have long shaggy manes. Animal-loving aborigines may long ago have carried this animal in their canoes to distant islands that had no native deer.

WE KEEP HOUSE ON AN ACTIVE VOLCANO

After Flying to Study a Spectacular Eruption in Belgian Congo, a Geologist Settles Down on a Newborn Craterless Vent for Eight Months' Study

By Dr. Jean Verhoogen

University of Brussels

EARLY in February, 1938, news came through to Belgium that an eruption had started at the volcano Nyamlagira in the Albert National Park, Kivu District, Belgian Congo.

The watchful superintendent of the park, who had been observing the volcano for many years, had predicted the eruption for early in 1938. His predictions were fulfilled on January 28, when the volcano erupted in an extraordinary manner.

A number of huge fissures opened on the southeastern and southwestern flanks of the mountain, a deluge of lava poured out, rushed down at terrific speed, set hundreds of square miles of forest on fire, and trapped large numbers of antelope which were later found completely carbonized.

Tremendous founderings occurred in the crater as a result of the drainage of lava through the fissures. The pools collapsed into a deep chimney, and the crater presented a scene worthy of Milton's description of Chaos in *Paradise Lost*.

The superintendent was at the crater of the volcano at the time of the eruption. He had seen the beginning and had sent reports which indicated the eruption was unusual, scientifically interesting, and spectacular (page 526).

GEOLOGISTS, IF NOT LAYMEN, WELCOME VOLCANIC ERUPTIONS

Geologists welcome news of a volcanic eruption, as it affords them a chance to gain information concerning the processes active inside our earth. An opportunity as good as this could not be missed.

The University of Brussels (Cassel Fund) decided to co-operate with the National Park Institute and offered me the opportunity of flying to the park to study the eruption.

The idea of a volcanological investigation at Nyamlagira had been my dream for many years before the eruption; consequently, I knew fairly well how I wished to plan for such an undertaking.

It is one thing, however, to prepare leisurely for an expedition with plenty of time ahead; and another to be thrust into an airplane bound for mid-Africa, with an allowance of exactly 200 pounds of luggage, oneself included.

I remember little of those three days in the air from Marseille to Port Bell, Uganda. Weather was bad and we flew rather high all the way. In the intervals between considering air sickness as much more than a remote possibility, my thoughts were occupied mainly with the volcano.

For all I knew, the eruption might have stopped by that time, or the volcano might object to my intrusion. In either event, there would be no use en route for the new camera which was traveling under heavy seals in a separate compartment, since Italy and Greece were then forbidden lands for amateur aerial photographers.

TO THE EQUATOR, WITH WARM CLOTHES

Having been warned of the cold weather that usually prevails at high altitude on the volcano, I was carrying warm and thick clothes with me.

I realize they probably looked a bit comic in Khartoum, but they came in handy on the volcano where the temperature, in spite of the glowing lava, would commonly drop to a mere 41° F., which, for an erupting volcano right under the Equator, is admittedly very low.

When I got off the plane at Port Bell, on Lake Victoria, however, I indulged in a few shirts which looked more like the local style than did my heavy camel's-hair coat worn from Europe.

The distance from Lake Victoria to the Albert National Park in the Belgian Congo is just a long day's ride (map, page 515).

The headquarters of the park are located at Rutshuru, halfway between Lake Edward and Lake Kivu, some 22 miles northeast of Nyamlagira.

Photograph by Randolph A. Christie

HEADSTRONG!

A Wakutu tribesman of Ruanda, Belgian Congo. His forebears years ago were subjugated by the tall Watussi (Batussi), when those warriors invaded the Wakutu homeland from the north. Pygmies form a third tribal group in this province.

Necessary camping equipment was obtained there, and porters were recruited in sufficient number to carry the indescribable jumble of pots and pans, chairs and tables, beds and tents, chickens and bananas, which make up any well-organized safari. From the road to the top of Nyamlagira constitutes a two days' hike. The climb is exceedingly easy, as the slopes of the volcano are in no place very steep.

Nyamlagira, 10,026 feet above sea level, is the westernmost of the Virunga volcanoes. The Virunga volcanic range, north of Lake Kivu (pages 518-9), is one of the youngest features, geologically speaking, of the African Continent. This group of eight huge volcanoes rises from the floor of, and stretches across, the Western Rift Valley, about 1° 30′ south of the Equator (page 514).

THE COLOSSAL RIFT VALLEY

The Western Rift Valley is a branch of the Great Rift Valley, that narrow, sunken area which, cutting across the highest land along its course, extends from Mozambique up through East Africa and along the Red Sea into northern Syria. In the Dead Sea its floor is below sea level; whereas its walls rise in places to 10,000 feet, or more.

Geographically and geologically speaking, the Great Rift Valley is one of the most important and prominent features of the face of the earth. The Western Rift Valley, 850 miles long, contains Lake Tanganyika, one of the deepest lakes in the world, with a bottom 1,600 feet below sea level, the basins of Lakes Kivu, Edward, and Albert, and also includes sections of the Nile Valley.

THESE VOLCANOES MERE YOUTHS

It is not known exactly when volcanic activity began in the Virunga group ("Virunga"—Volcano). There are many indications, however, that most of the volcanoes are not very old; they may, indeed, be contemporaneous with man. There is good evidence that in times not far back Lake Tanganyika was flowing northward towards Lake Edward and the Nile. Neither Lake Kivu nor the volcanoes existed at that time.

Then tremendous movements occurred, and volcanic activity was initiated. As a result of this activity, a river flowing northward was dammed behind a rising wall of lava, thus bringing into existence Lake

Photograph by Jean Verhoogen

ON SAFARI TO THE VOLCANOES, THE AUTHOR PUTS UP FOR THE NIGHT

From Rutshuru, headquarters of Albert National Park in the Belgian Congo, Dr. Verhoogen set out for Mount Nyamlagira, some 22 miles to the southwest, or 30 miles by road. Porters carried furnishings to equip a camp on the side of the seething inferno. The hike from the main road to the 10,026-foot peak through wilderness took two days.

Photograph courtesy Belgian Ministry of Colonies

TRIBESMEN CONFER WITH THEIR CHIEFTAIN AT RUTSHURU

Aristocrats of the clan wear silken togas. Their meeting place is in the "capital" of Albert National Park, eastern Belgian Congo. This preserve of 3,300 square miles, in the Western Rift Valley (page 512), embraces the Virunga Mountains and part of Lake Edward, and extends to Lake Kivu.

Photograph by F. J. Erroll

RUANDA NATIVES CALLED THIS ROW OF VOLCANIC PEAKS "THE KITCHEN"

The mighty Virunga Mountains, also known as the Mufumbiros, in the Western Rift Valley, were explored by the American sculptor, Carl Akeley. Here in the forests of Kivu District he found gorillas, elephants, and many other wild animals. Here he also made friends with the Pygmies and taller tribesmen (page 512). The explorer's ashes rest on the slopes of Mount Mikeno, an eminence in the Virunga range.

Drawn by Ralph E. McAleer

MOUNT NYAMLAGIRA, ERUPTING WITH PENT-UP FURY, SHOWERS SEETHING LAVA INTO THE HEART OF AFRICA'S BIG GAME COUNTRY

The 10,026-foot peak, westernmost of the eight huge volcanoes that make up the Virunga range, rises from the floor of the Western Rift Valley, about 100 miles south of the Equator. Gorillas, elephants, antelopes, and a host of other wild creatures inhabit the forests of this area, a part of Albert National Park, vast natural reserve of the Belgian Congo. The upper inset shows in detail the area affected by the flow of molten lava. The lower inset shows Nyamlagira's relative position on the African Continent.

Kivu. Its waters were soon thrown back southward towards Lake Tanganyika, which had to seek a new outlet for itself.

Now its waters, and those of Lake Kivu, run west through the Lukuga River into the Congo Basin. The Congo-Nile Divide, of which the Virunga range is a part, was thus displaced for many miles to the north.

One can well imagine how disturbing an event the birth of a volcanic range may be. As the volcanoes rose higher and higher, the lavas spread ever farther, extending south and north and piling up against the walls of the Rift Valley.

BIRTH OF A VOLCANIC RANGE IS A DISTURBING EVENT

Mountains were born which now rise more than 14,000 feet, towering a good 11,000 feet above the floor of the valley.

Photograph by Jean Verhoogen

LAVA SHEETS BUILD UP A TORTOISE-SHELL BACK FOR NYAMLAGIRA

The lava, exceedingly fluid, spreads out thinly. The sheets pile up on each other as they cool, assuming a peculiar shape. This type is known to geologists as a "shield volcano" (page 526).

Photograph by G. Michel

A ONE-MAN "BUTTERFLY NET" BRINGS IN PLENTY OF FISH ON LAKE KIVU

Suddenly applying pressure on the ends of the two poles, the fisherman raises the submerged net in a jiffy, trapping all the fish between the mesh and the surface of the water.

SHAMBENE SMOKES AND GLOWS AT THE FOOT OF NYAMLAGIRA

From the edge of the tall mountain's crater the author made this photograph of the new volcano, bursting forth at the base of the old (page 526).

Photographs by Jean Verhoogen

SHADES OF NIGHT FALL UPON SHAMBENE

Yellow flames are visible at the mouth of the cones. Clouds of smoke reflect the glow from the incandescent lava. The lava "river" wriggles down into the plains.

Photograph by G. Michel

IN THE DIM PAST, HUGE WALLS OF LAVA ROSE TO DAM UP LAKE KIVU

The lovely, mountain-locked sheet of water, 4,800 feet above sea level in the Western Rift Valley, has been likened by some travelers to the Bay of Naples. North of the lake lie the Virunga (volcano) Mountains.

DUGOUTS TRAVERSE ALMOST-BOILING WATER, WHERE HOT LAVA FLOWS INTO LAKE KIVU

Steam rises from the surface, which is covered with an oily, black scum. On shore, vegetation succumbs to the molten streams.

Photographs © Captain C. R. S. Pitman

STEAM, SMOKE, AND LAVA SPREAD OVER THE TWO-MILE-WIDE CRATER AT NYAMLAGIRA'S SUMMIT

© Captain C. R. S. Pitman

SPOUTING SULPHUR CHIMNEYS RESEMBLE MINIATURE VOLCANOES

Steaming fumes shoot from the cones, some of which rise to a height of 60 feet on erupting Nyamlagira. About their steep sides lie congealed masses of twisty and curly melted sulphur.

Photograph by G. Michel

EVERY DAY IS HALF-HOLIDAY FOR VILLAGERS IN THE KIVU LAKE REGION

Back of the thatch-roofed houses lie the fields, where these African tribesmen worked until midday. Now they are whiling away the afternoon hours in languid conversation. Being out of the path of flowing lava, villagers showed little interest in the eruption of Nyamlagira.

Photograph by G. Michel

"HOTEL OF THE VOLCANOES" ON LAKE KIVU COMMANDS A VIEW OF SOARING CONES

The modern hostelry in Ngoma, at the northeastern corner of the lake, is headquarters for many travelers who come to see the volcanic regions to the north. Near by is the prosperous settlement of Kisenyi, in the territory of Ruanda-Urundi, since the World War under mandate of Belgium, and once a part of German East Africa. The territory is administered as a part of the Belgian Congo.

Photograph by G. Michel

BELGIAN ENGINEERS TRANSFORM A HAZARDOUS MOUNTAIN TRAIL INTO A MODERN HIGHWAY

Between Sake and Costermansville a new road, opened a little more than a year ago, pierces the heart of the Kivu mountains for a stretch of more than 100 miles. It is so narrow that northbound and southbound traffic must use it on alternate days.

Photograph by G. Michel

BABY NAPS ON MOTHER'S BACK AS SHE WORKS IN THE FIELDS

Only a slender leg reveals the presence of a shy little boy behind the woman in foreground, who is wielding a wooden hoe. Men in the Kivu District of the Belgian Congo take no part in tilling the soil. Their duties are done after they have cut down the trees and cleared out the brush, reclaiming the land for cultivation.

They acted as an effective barrier to the invasion of the cattle-owning Batussi people, who settled on the southern slopes and never crossed the mountains.

As a result, utterly different conditions, both economic and social, were established on either side of the range.

LAVA ACTS AS FERTILIZER

Changes in the topography have wrought changes in the climate. From the sultry plains to the everlasting fogs on the mountains the variety is extreme and has resulted in incredibly different types of vegetation, some of which would have been utterly unknown in the region except for volcanic action.

A new habitat was created for man. Cattle settled on the lower slopes of the mountains; and in the extinct craters, filled now with fertile soil, native villages emerged in the midst of beans and bananas.

Because of their high potash content, the lavas acted as fertilizers, yielding, after a few centuries, wonderful soils on which vegetation develops rapidly. Instead of the meager, desiccated, and thorny bush that covers sparingly the floor of the valley, the slopes of the range are filled with lush vegetation and luxuriant forest, a favorite haunt of elephants and leopards.

BAMBOOS AND GORILLAS

Higher up on the mountains groves of bamboos are evident, as are also numerous gorillas, thriving within the protection of the boundaries of the Albert National Park. Beyond the bamboo forest and the *Ha-*

Photograph by G. Michel

HOMEMADE CANOES PLY LAKE KIVU WITH PRODUCE FOR SAKE'S MARKET

Tribesmen row their dugouts, laden with fruit and vegetables, across the mirror surface of the lake from their hamlets to the settlement. In Sake they bargain with Hindu merchants for cheap cotton goods and imported foodstuffs.

genia abyssinica, or paperbark tree, at timber line, one enters the fascinating region where vegetation resembles nothing that one has ever seen except, perhaps, in dreams of the moon.

Struggling up through giant groundsel and candlelike lobelias, 12 or 15 feet high, one reaches a zone where vegetation is scarce and snow not infrequent (pages 546 and 549).

Up to the very summit of the less accessible peaks—all of them extinct volcanoes of which nothing is left to remind the climber that they were once mountains of fire—life remains abundant and indomitable.

In the topmost regions birds, beetles, and the klipspringer, *Oreotragus oreotragus,* a mountain antelope, carry on a successful struggle for existence.

Volcanic activity has thus created a new world of its own, enclosed by and restricted to the mountains themselves.

VOLCANOES STILL AT WORK

The work of the volcanoes is by no means completed yet. The two westernmost volcanoes, Tshanina Gongo, or Nira Gongo, and Nyamlagira are still very much alive. Numerous eruptions have been recorded in this region, the latest of which occurred in 1912, when a new volcano was formed a few miles north of Lake Kivu.

This one, Rumoka by name, remained active for several weeks. Its lavas, running down to the lake, almost completely filled up a strait between two promontories, practically cutting off a bay from the main lake.

Of these two volcanoes, Nyamlagira, the object of my special study, is a very peculiar

one. It closely resembles Hawaii's Kilauea, which belongs to a distinctive type (Hawaiian type) of volcano, of which very few, if any, other examples are known to be active at the present time.*

Considering the geological and geographical differences between Hawaii and the Kivu region, it is very surprising indeed that such a degree of similarity could be attained in spite of these divergences of prevalent conditions.

Hawaii, of course, is a central Pacific island of a group lost in the midst of an ocean which is one of the greatest and most nearly permanent features of the earth. Nyamlagira, on the contrary, is located on the very backbone of the African Continent, one of the most ancient, lasting, and "continental" of all continents.

These facts alone may serve to prove that volcanic activity has very little to do with geographical conditions. Sea or land, ocean or continent, mountains or plains, plateaus or rift valleys, from one pole to the other volcanoes may burst forth regardless of geographic environment.

A HAWAIIAN VOLCANO TYPE

As I have stated, Nyamlagira shows the attributes of a Hawaiian volcano. Just what are the distinctive features of this volcanic type? First of all, the lava is usually exceedingly fluid. It flows almost like water, spreading out as thin sheets over vast areas.

The volcano which is built up as a result of these sheets piling on top of each other assumes a peculiar shape, a form more like a tortoise shell or a shield than a true volcano. In fact, these volcanoes are known geologically as "shield volcanoes" (page 516).

AFFORDS FANTASTIC SPECTACLE

Their most peculiar feature is perhaps the uncanny manner in which they manage to remain active for months or years without spilling a single ounce of lava.

The lava remains dammed up in pools, or lakes, in the crater. It is very hot (lava, of course, is molten rock at a temperature around, say, 2,000° F.) and would cool down rapidly and become solid were it not for a most ingenious circulatory system which keeps it in motion all the time.

The lava, when it begins to stiffen and congeal, is drawn aside under one bank of the lava lake, sinks down to some unknown depth, becomes reheated and, by some process or other, turns upward again and reenters the lake from one side.

NATURE'S INGENIOUS LAVA PERCOLATOR

The pasty mass of molten rock is thus maintained in a state of constant agitation. Gases, which rise to the surface of the lava as big splashing bubbles, burn with a beautiful yellowish-green tinge. At night the lake becomes a fantastic scene of bright, incandescent lava, which appears to be boiling in the midst of phosphorescent flames.

Nyamlagira had displayed activity of this kind for many years previous to the 1938 eruption.

Several lava pools located inside the main crater, two miles wide, displayed the typical features of Hawaiian activity. They would occasionally overflow, and a thin flow of lava would spread over the floor of the crater. In this manner the crater was slowly becoming filled.

It soon became clear that when it would be full to level, the lava would overflow and spread out on the slopes, and a true eruption would occur.

THE BIRTH OF A VOLCANO

It did, as stated, on January 28, 1938, and about the time of the eruption I have described (page 511), an explosion occurred at the foot of the mountain at a place called Shambene.

A new volcano was born!

This new volcano was peculiar. It lacked one of the essential characteristics of a volcano—a crater.

Otherwise it possessed many features of unusual type which any volcano would be proud to own (page 517).

There was a lava lake, one of those rare lava lakes which delight scientists; there was a lava stream, an actual river of lava issuing from the ground at the foot of a cliff and flowing down leisurely like any ordinary stream of water; and there were also a number of cones and gas vents, mounds some 50 feet in height from which

* See, in the National Geographic Magazine, "Hawaiian Islands: America's Strongest Outpost of Defense—The Volcanic and Floral Wonderland of the World," by Gilbert Grosvenor, February, 1924; "Hawaii, Then and Now," by William R. Castle, October, 1938; and "Bird Life Among Lava Rock and Coral Sand," by Alexander Wetmore, July, 1925.

SABLE ANTELOPES MADLY FLEE A STRANGE PURSUER FROM OUT THE SKIES

Close on their heels the shadow of the photographer's plane rushes relentlessly. The wary sprinters were surprised while grazing on the Gorongosa Plains of Mozambique.

Photographs © Reginald A. Bourlay

CAPABLE FIGHTERS, BUT PACIFISTS, THEY PREFER PELL-MELL RETREAT

When cornered, sable antelopes battle furiously with their sweeping, thickly ringed, scimitar-shaped horns, grown by both male and female. Mr. Bourlay, a pilot for the Rhodesian and Nyasaland Airways, Ltd., made this series of remarkable aerial photographs while on regular trips to various parts of southern Africa.

© Reginald A. Bourlay

FROM THE BASE OF LOFTY, SNOW-CAPPED KILIMANJARO, BIG GAME TRAILS RADIATE THROUGH TANGANYIKA UPLANDS

On safari to this 19,300-foot eminence, travelers encounter elands, gazelles, a few lions, zebus, lesser kudus, and other African wild life. Usually the towering giant is wrapped in clouds. The photographer pushed his plane to an altitude of 14,000 feet, at 6 o'clock in the morning, to make this picture.

© Reginald A. Bourlay

AIR-MINDED GIRAFFES ON THE BUHORO FLATS MOVE LEISURELY FROM THE PATH OF AN ONCOMING PLANE

Curiosity stays the retreat of the animal in foreground. The long-necked denizens of this wild section of Tanganyika are accustomed to the drone of motors in the skies, for they dwell on the route of the Imperial Airways. Here the photographer saw more giraffes than in any other part of Tanganyika or Kenya (542).

© Reginald A. Bourlay

WHITE-BELLIED STORKS FILL THE AIR OVER A TEMPORARY STOPPING PLACE, AS THEY COMMENCE THEIR SOUTHERN MIGRATION

Exodus from Tanganyika begins when the rainy season sets in, about mid-November. The birds, also known as "rainbirds," "farmers' friends," or Abdim's storks, travel in flocks of about 400.

© Reginald A. Bourlay

PUGNACIOUS AFRICAN BUFFALOES STAMPEDE AT THE SIGHT OF THE NOISY "BIRD" DROPPING FROM THE CLOUDS

Flying hoofs thunder over the dusty Gorongosa Plains of Mozambique as the animals dash for safety. Some 700 make up the herd (page 533).

© Reginald A. Bourlay

DISTURBED IN THEIR MARSHLAND HAUNTS, NOISY LECHWI SPLASH AND BOUND ACROSS A SHALLOW STREAM

Soaring over the Kafue flats of Northern Rhodesia, the aviator-photographer came upon this herd of antelopes which are closely related to the waterbucks. When alarmed, they sound forth in a perfect chorus of loud grunts before taking to flight. Their spread hoofs come down with resounding smacks in the mud and they leave large tracks. "I consider this to be one of my best photographs," Mr. Bourlay writes.

© Reginald A. Bourlay

ONLY ABOARD A PLANE IS MAN SAFE IN THE PRESENCE OF A STAMPEDING HERD OF AFRICAN BUFFALOES

Although this large band roams the Gorongosa Plains of Mozambique at will (page 531), the beasts are much less numerous throughout East Africa than they were before 1890, when they occurred in countless thousands. During that year they were afflicted with the rinderpest, or cattle plague, and were greatly depleted. African buffaloes are among the most dangerous big game animals, particularly when wounded. Both male and female have horns, the former with large bosses at the base.

LIONS, SURPRISED IN OPEN DAYLIGHT, HUSTLE FOR COVER

The beasts seldom are seen from the air on the Cheringoma Plains of Portuguese East Africa. They usually lurk in thickets and other places of concealment.

Photographs © Reginald A. Bourlay

A RULER OF THE JUNGLE BEATS A SOLITARY RETREAT

It's every beast for itself when the plane roars down on the tribe. Usually these Musongwe lions move about in groups numbering up to eight.

JUMBO, LEADER OF THE HERD, STANDS HIS GROUND AS THE PLANE NEARS

In fighting posture, he extends his broad ears to catch every sound. On a flight to the tin mines of Manono, Belgian Congo, Mr. Bourlay encountered the elephants in swamps south of the Kibara Mountains.

Photographs © Reginald A. Bourlay

FEARLESS AND DEFIANT, THE OLD BULL CHARGES THE WINGED INTRUDER

Dashing ahead of his fellows, the elephant lunged toward the plane just as the photographer snapped the picture. Hastily the downward flight was checked and the plane roared over Jumbo's head.

© Reginald A. Bourlay

WONDERS OF VICTORIA FALLS ARE REVEALED WEEKLY TO PASSENGERS ON THE REGULAR BULAWAYO-LIVINGSTONE AIR ROUTE

Waters of the Zambezi River, flowing over an even sheet of basalt, plunge abruptly over the edge of an almost vertical chasm. Here the river is more than 1800 yards wide. From 62 to 100 million gallons of water pour over the edge every minute. Only when the Zambezi is very low is it possible to look into the depths of the chasm 420 feet deep at its center, because of the clouds of spray. David Livingstone discovered the spectacular falls in 1855.

© Reginald A. Bourlay

GIANTS OF THE JUNGLE TIRELESSLY COVER MANY MILES A DAY WITH THEIR SHUFFLING, GLIDING GAIT

Although they are moving swiftly over the Gorongosa Plains, they never run or gallop. Since elephants cannot jump and their stride is only about six and a half feet, a ditch seven feet wide will halt their progress. Builders of barless zoos confine their pachyderms behind straight-walled moats about ten feet wide. Despite their huge size, the animals are stealthy stalkers. An entire herd can leave a forest and disappear without breaking a twig or making a sound.

© Reginald A. Bourlay

STROLLING LEISURELY ACROSS THE GORONGOSA PLAINS, THESE CONTENTED ELEPHANTS NEED FEAR ONLY MAN

Colossal bulk of the pachyderms safeguards them from attack of all other animals except outlaws from the herd. No enmity exists between Jumbo and other jungle monarchs such as hippopotamuses, rhinoceroses, lions, or buffaloes. Baby elephants are energetically protected by their elders.

© Reginald A. Bourlay

BILLIARD BALL MAKER'S DREAM—A TON OF IVORY IN THE RAW ON THE GORONGOSA PLAINS

Tusks of African bull elephants average about 40 pounds apiece. Those weighing 100 pounds are not rare. One has been recorded which weighed 235 pounds and had a circumference of 26 inches. Old bulls with big tusks find it difficult to keep up with the herd. Sometimes they lodge the big teeth in forks of trees to give their weary neck muscles a rest.

© Reginald A. Bourlay

NATURE'S CAMOUFLAGED HORSES COULD REDOUBLE THEIR SPEED IF A LION WERE AT THEIR HEELS

The airplane does not inspire as much terror as the king of the jungle, which preys upon zebras. Leo must stalk his quarry carefully, for the fleet runners can outstrip him on open stretches, such as this section of the Buhoro Flats in Tanganyika. Against other animals zebras are brave, attacking savagely with their hoofs. Because of their stripes, the animals are barely discernible against a background of scrub growth.

© Reginald A. Bourlay

UNWIELDY HIPPOPOTAMUSES, MILD AND INOFFENSIVE, MILL ABOUT IN THE COOLING WATERS OF THE SUNGUE RIVER

Roar of the airplane motor only slightly disturbs this East African herd in quiet search for underwater plants, a favorite diet. When wounded, or defending their young, the bulky beasts are remarkably agile and immensely strong. Sometimes the old bulls, like elephants, become "rogues" and attack anything and everything within sight. Hides of the huge animals are two inches thick in places and are virtually hairless.

RUBBERNECK COMES TO ATTENTION AS THE PLANE'S SHADOW NEARS HIS PATH

Leaves of trees on the Buhoro Flats of Tanganyika (page 529) interested this giraffe until it heard the plane. Instead of fleeing, it merely stretched its long neck upward as far as possible for a good look.

Photographs © Reginald A. Bourlay

OVER THE ATHI PLAINS OF KENYA A GIRAFFE RACES AT FULL SPEED

These tallest mammals can run thirty miles an hour. They sometimes grow to a height of 18 feet 7 inches. Once giraffes were found in large herds, but hunters have caused their extermination in many districts.

belched flames and bits of molten lava.

All these attributes—lava lake, stream, and cones—were scattered in various places, at distances of several hundred yards; and there seemed to be no visible connection between them. It is not certain that the lava in the lake had anything to do with the existence of a lava stream and gas vents half a mile away.

LAVA FROM A CRATERLESS VOLCANO

For weeks and for months the lava has been flowing down into the stream. It spreads out in the plains at the foot of the mountain and covers several hundred square miles, advancing relentlessly south, west, and north, on a very large front. Nothing is left of the magnificent forest. Herds of elephants have fled, and everywhere the sight is one of utter destruction.

The stream of fire has now reached the northwestern corner of Lake Kivu, into which it is flowing amid gushing columns of steam. Fish, somewhat surprised at the intrusion, are given little opportunity to think the matter over, to the great joy of the natives who follow the process with eager expectation of boiled fish for supper.

GROUND HOLES BELCH FLAME

At the volcano itself the sight was most unusual. Holes in the ground were belching huge flames, several yards high. Sheaves of incandescent material were blown high into the air from the cones and then fell back on the ground flat as pancakes.

The lava lake was like a lake of fire. Bubbles of gas were gushing through the molten, bright-orange rock, which sprang up as fountains of liquid fire. Heavy blue clouds of smoke with a pungent smell of sulphur would stick to the ground, drowning the landscape in a deadly haze.

When I reached the volcano about a month after the beginning of this phenomenon, I established my camp a few hundred yards above Shambene, in a forest of giant heather. From this vantage point I commanded a wonderful view of the volcanic display.

SETTLING DOWN TO COMFORTS OF HOME—ON A VOLCANO

I remained there permanently from February to October, devoting my time to the study of this extraordinary spectacle. Fortunately, Shambene could be approached quite easily, if care were taken to remain out of the wind; and it offered unusually good opportunities for a close study.

On the whole, life on the volcano was quite comfortable, except for the rains and lasting fog. The native porters built themselves huts with which they seemed well satisfied. They would be content with almost any type of construction provided it kept out rain and kept in the smoke.

They spent their time running up and down the mountain, carrying supplies, fresh milk, and vegetables, all of which they brought up daily from a distance of about twenty miles. Strangely, the eruption seemed to make no great impression on them, and they paid practically no heed to the lava, which, to them, is just "fire."

The people on the northern slopes of the volcano, from whom the porters were recruited, appear to be as a whole a rather unimaginative lot; and I could not find out whether they had any tales or legends relating to the volcanoes. It seems probable that they have none.

The country immediately around Nyamlagira is practically uninhabited because of lack of water; consequently, the natives suffered very little from the eruption and, as a result, had little or no interest in it (page 521).

To me outdoor life over long periods of time is far more comfortable in wild Africa than in the so-called "civilized" countries.

THEY GOT ALONG WITH 3 PORTERS AND 3 WORDS VERY WELL

But when one realizes how truly comfortable and luxurious it feels to go around with never less than three porters—one for the camera, one for the tripod, and the third as a spare—a fresh outlook is gained. Then this part of Africa seems no longer such a backward place, and the advantages of civilization become less obvious.

I never quite understood how my porters and I got along as well as we did considering the fact that we probably didn't understand more than three words of one another's language. True, much can be expressed in three words, provided they mean "go fetch food."

Each tribe or social class of natives has a language of its own, which is usually difficult grammatically, each word having infinite shades of meaning.

Fortunately, a sort of international language, derived from the Swahili of the

Photograph by Sir Bernard Bourdillon

LONG-HORNED ANKOLE CATTLE ORIGINALLY CAME TO RUANDA WITH THE WATUSSI

When the conquerors entered the country they brought their herds with them. Thousands of the animals have been killed by rinderpest, or cattle plague, since 1896. Recently modern dipping methods have made progress in combating the disease.

Photograph by G. Michel

THE VILLAGE SMITH SITS BEFORE HIS ANVIL OF STONE

Bellows of animal skins and a hollowed double tree branch conduct the air to the forge. With a piece of iron for a hammer, the blacksmith makes knives and hoes.

ONLY WOMEN THUMP THE POTTER'S CLAY IN THE BELGIAN CONGO

To make a new jug, she uses an old one for a model and shapes the prepared clay over it. Then she sets the new one in the sun to dry and afterwards bakes it. The finished product is used to fetch water from a near-by stream.

Photographs by G. Michel

BABY ON BACK, MOTHER COMES TO MARKET TO BUY A LITTLE SALT

The stall is in the market place of Sake, flourishing hamlet at the northwestern corner of Lake Kivu, in the Belgian Congo (page 525). Lava from erupting Nyamlagira flows into the lake.

© Captain C. R. S. Pitman

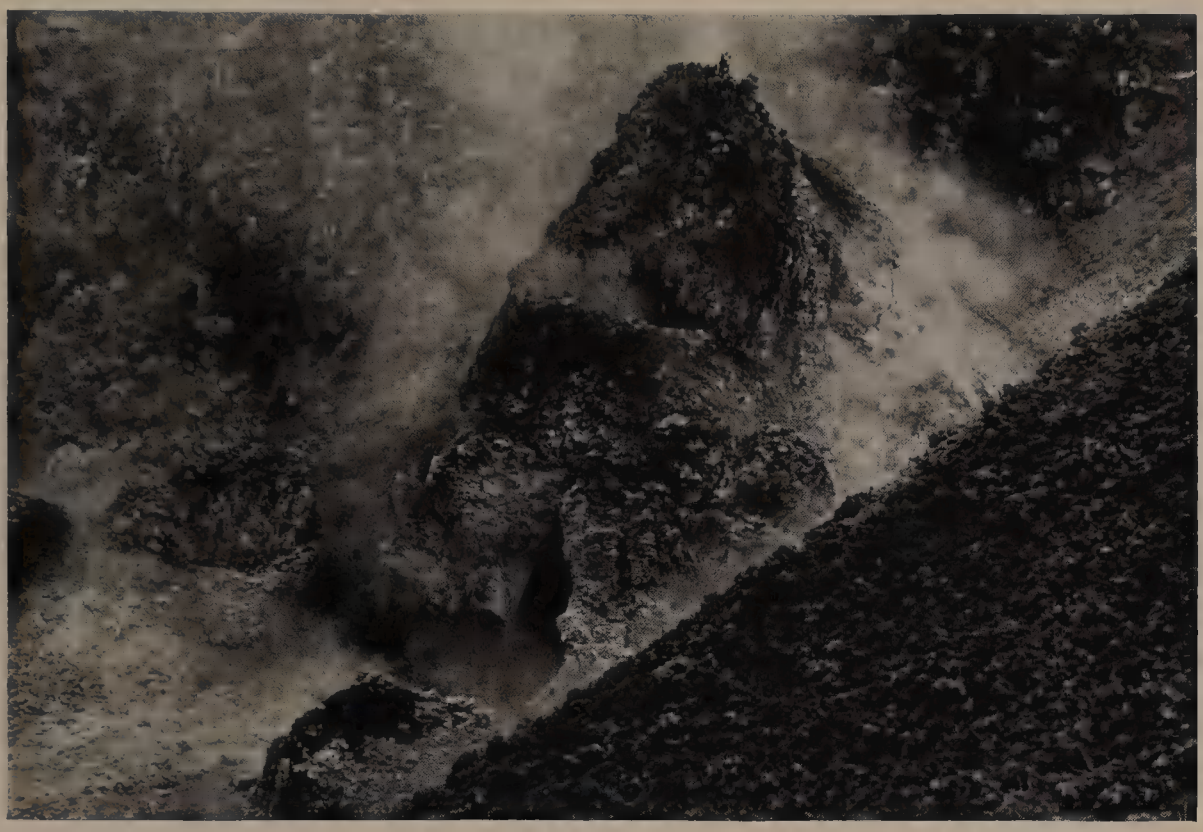
ON NYAMLAGIRA'S SLOPES STRETCHES A SCENE OF BLACKENED DESOLATION

As far as the eye can see there is lava, lava, lava. The cooling, solidified substances, in weird shapes and formations, have swallowed up the countryside. Some segments are high up in the dead trees.

Photograph by Jean Verhoogen

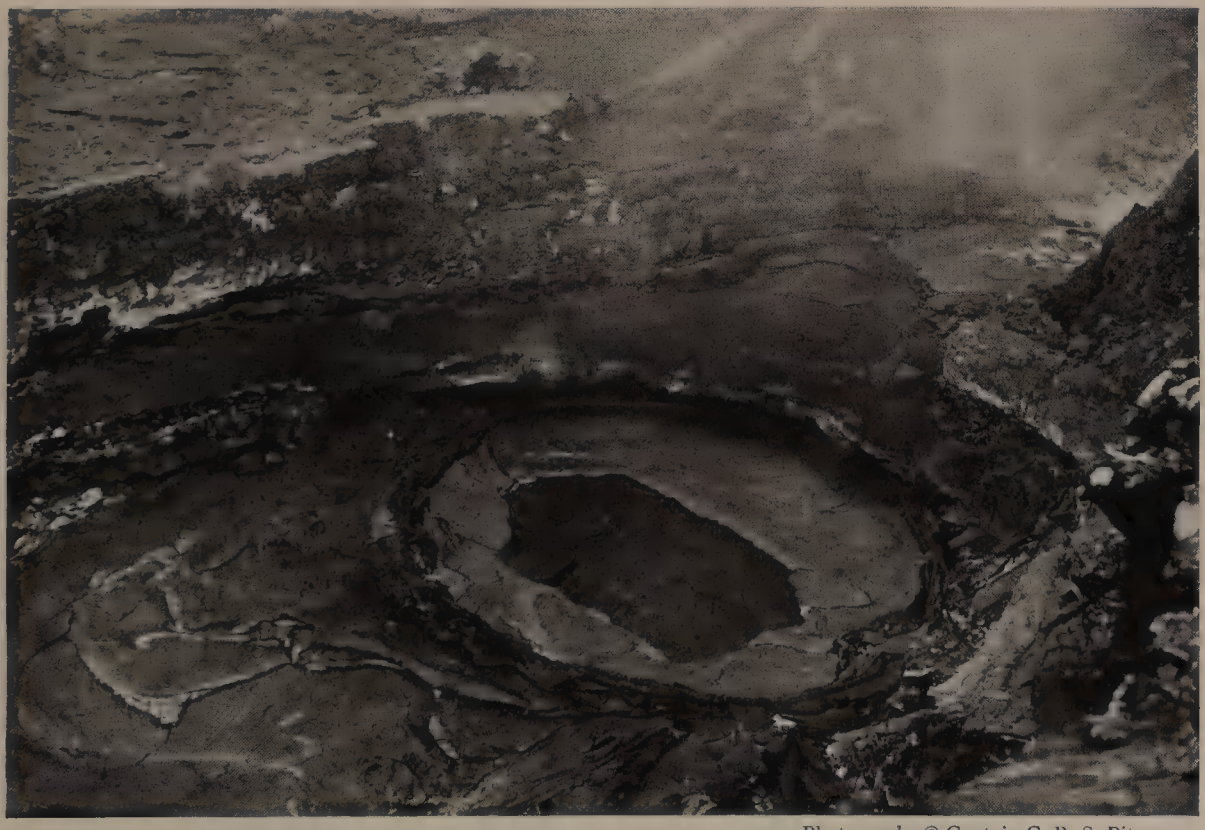
AS SOON AS THE LAVA COOLS, HARDY GROUNDSEL TAKES ROOT

The stretch of solidified lava in which the plant is bravely blooming was a molten mass only three months before the author made this photograph. This shrub may grow to 15 feet (page 525).



FUMES SHOOT FROM A WIDE, ABYSMAL SULPHUR VENT

Bright-yellow deposits and crystals line the terrifying pit on Nyamlagira. The gaping aperture has no visible ending.



Photographs © Captain C. R. S. Pitman

A SEETHING NEW CRATER BURSTS FORTH ON NYAMLAGIRA

Except for the small, dark island in the center, this focal point of eruption is a flame-red lake of glowing molten lava—a boiling mass!

Photograph by Dr. Franz Stoedtner

WATUSSI BOYS DANCE THE "BOW AND ARROW COMBAT"

Sons of the tall aristocrats of Ruanda, Belgian Congo, keep alive the traditions of the original conquerors of the country. Many of the men are more than seven feet tall. They excel at high jumping, often clearing the bar at a height of seven and a half feet.

Photograph by G. Michel

RHYTHMIC POUND OF THE PESTLE LULLS BABY TO SLEEP

A band stretched from the mother's forehead supports the little fellow upon her back while she grinds meal for the family dinner.

Photograph by Vittorio Sella

A GIANT LOBELIA STANDS SENTINEL ON THE MOUNTAIN SLOPE

This plant, with its tall spikes, is related to the smaller annual or perennial herbs of the same name. It thrives at high elevations (page 525).

eastern coast, has spread over all of eastern and central Africa and is very much used between natives and natives, between natives and Europeans, and sometimes also between Europeans of different countries. By this extensive use the language has become very much simplified, and one can make oneself understood with relatively little effort.

ERUPTION SHOWED NO SIGNS OF WANING AFTER 8 MONTHS

About eight months were spent on the volcano, and still the eruption showed no signs of waning. The lava was running as fast and as abundantly as on the first days. Ample opportunity was given for a close study of the phenomenon, and much data could be secured on the temperature of the lava, the burning gases, etc.

The problem of the mechanics of volcanoes is one of the most fundamental problems of geology. Unfortunately, the work at Nyamlagira was interrupted, partly for lack of money and time.

Nyamlagira is certainly an outstanding volcano and one of the most favorable places on earth for detailed studies of volcanic activity. It is our hope that scientific research will be continued and a permanent observatory established there in the near future.

TIMELY ARTICLES AND MAPS GIVE GEOGRAPHIC MEMBERS BACKGROUND OF EUROPEAN DRAMA

MEMBERS of the National Geographic Society are reminded that their Magazine, in the past 12 months, has presented a series of authoritative articles which give the background of areas involved in the present European situation, and also neutral countries which seek to keep out of the maelstrom.

Earlier featuring of European places, including dozens of articles and hundreds of natural-color and monochrome photographs, may be located by quick reference to the *Cumulative Index to the* NATIONAL GEOGRAPHIC MAGAZINE.

The pertinent articles of the past year include the following:

"The Farthest-North Republic" (Finland), by Alma Luise Olson, October, 1938.

"An American Girl Cycles Across Romania," by Dorothy Hosmer, November, 1938.

"The Transformation of Turkey," by Douglas Chandler, January, 1939.

"Time and Tide on the Thames," by Frederick Simpich, February, 1939.

"The Smallest State in the World" (Vatican City), by W. Coleman Nevils, March, 1939.

"Country Life in Norway," by Axel H. Oxholm, April, 1939.

"Pedaling Through Poland," by Dorothy Hosmer, June, 1939.

"Land of Europe's Youngest King" (Yugoslavia), by Douglas Chandler, June, 1939.

"Looking Down on Europe Again," by J. Parker Van Zandt, June, 1939.

"Life's Flavor on a Swedish Farm," by Willis Lindquist, September, 1939.

The maritime aspect of the international situation may be followed with the aid of the Map Supplement of the Atlantic Ocean sent to members with their July, 1939, issue, which also contained the article on "The World That Rims the Narrowing Atlantic," by James M. Darley.

With the Atlantic Map, and the timely Map of Central Europe and the Mediterranean in this issue, members will be able to locate datelines and follow every phase of political and military activity.

War Clouds Over Danzig and Poland's Port

Photograph by Rene Zuber, © C. Anders & Co.

AUGUST, 1939, HEADLINES! PEACE OR WAR?

German citizens of Danzig anxiously scan the daily newspapers in the window of a freshly painted tobacconist's shop. The venerable city on the left bank of the Vistula, four miles from the Baltic Sea, was the capital of West Prussia at the close of the World War. By the terms of the Treaty of Versailles, in 1919, the city and surrounding territory became a Free State, administered by the League of Nations, but in customs union with Poland. Adolf Hitler's demand that Danzig be returned to Germany, and Poland's refusal to agree to such a transfer, precipitated the world crisis of August, 1939.

Photograph from European

OCEAN-GOING VESSELS "TAXI" UP THE MOTTLAU PAST THE RIVERSIDE FRONT DOORS OF DANZIG

Two navigable branches of the stream split Danzig into three sections before they join the waters of the Vistula. The dome-topped building at the left is the old observatory and beyond it, extending over the water, stands the famous Crane Tower (page 555). The Vistula River connects Danzig with Poland and, by means of tributaries and canals, with Germany, the Ukraine, and Lithuania. Express trains speed to principal cities of Germany, Poland, and the Baltic States.

Photograph from European

FROM BERTHS ON THE MOTTLAU RIVER, DANZIG'S OWN SHIPS LEAVE FOR FARAWAY PORTS

Regular passenger and cargo sailings are listed to major harbors on the Baltic and North Seas, to London and Hull in England, even to New York and Philadelphia, and to Canadian cities.

Photograph by Rene Zuber, © C. Anders & Co.

COBBLESTONE ROADS LEAD INTO DANZIG FROM THE POLISH TOWN OF TCZEW

Here the border line runs north and south, with Polish territory to the west. The Free State, a little more than two-thirds the size of Rhode Island, with a population of 407,000, has land boundaries extending 147 miles. In addition to Danzig proper, and Zoppot, it embraces 254 villages and hamlets.

© Hanns Tschira from European

DANZIG STILL STORES CARGOES IN HER FIVE-CENTURY-OLD CRANE TOWER

Cumbersome machinery in the massive structure on the Mottlau River hoists foodstuffs and merchandise from the holds of ships tied up alongside. Two big treadwheels furnish motive power. The storehouse was built nearly half a century before Columbus sailed. Then Danzig was Poland's granary.

© Foto-Sonnke from Black Star

HALT! DANZIG BORDER GUARDS INSPECT AN AUTOMOBILE AT THE POLISH BOUNDARY

At Steinfliess, just outside Zoppot, on the road to Polish Gdynia, a woman traveler presents passport and permits. One guard is raising the barrier, which will permit the car with the Danzig license to cross to Polish soil.

Photograph from Ewing Galloway

MODERN GDYNIA, POLAND'S NEW WINDOW ON THE BALTIC, LIES AT THE TIP OF THE POLISH CORRIDOR

Only fishermen's rude huts occupied this site at the close of the World War. In the last 20 years a modern harbor with vast docks, warehouses, and giant coaling cranes has mushroomed into being. Poland built her own sprawling seaport here to lessen dependence on Danzig, twelve miles away. By 1937 Gdynia's imports of nearly a million and a half tons were double those of Danzig (page 558).

Photograph by Rene Zuber, © C. Anders & Co.

SOLARIUM APARTMENTS RISE IN MODERN GDYNIA, POLAND'S MADE-TO-ORDER SEAPORT

A drugstore occupies the first-floor corner. The city has been one of the fastest growing communities in the world, with a population jumping from only a thousand in 1919 to nearly 120,000 today (page 557).

THE SOCIETY'S NEW MAP OF CENTRAL EUROPE AND THE MEDITERRANEAN

EVER-CHANGING Europe—source of New World peoples and parliaments, printing and poetry, and much of our praying and planting—is delineated again in a timely map supplement distributed to members of the National Geographic Society with this issue of their Magazine.*

Because of the time necessary for printing more than a million copies of the map, the press run started on August 28. Should there be any changes of boundaries or names, these alterations will be made during the press run.

Such a change was made during the printing of the Map of Europe sent to members with their Magazine in April, 1938, when sovereignty over Austria was transferred to Germany.

Whenever a European boundary is shifted, a people freed or encompassed by a new sovereignty, or a familiar place name altered, that is homeland news for Americans, whether newly arrived or conscious of oft-told tales handed down through ancestral generations.

The course of European settlement can be traced across North and South America in the homes of the inhabitants, in the words they speak, the books they read, the food they eat, the churches where they worship, the songs they sing.

The Mediterranean, with all its 14,000-mile shoreline shown, was the cradle of navigation, sea-borne commerce, and international trade. From its peninsulas and islands came our laws, genius for organization, much of our architecture, the impulse for exploration which found the rich lands we live in.

NAMES RICH IN LORE AND SENTIMENT

Therefore the new Map of Central Europe and the Mediterranean, 36½ by 26½ inches, with its 6,212 place names, not only is an accurate chart for wall framing or desk reference, but a rich volume for the association of events with places indelibly engraved by history and etched into our daily lives.

Waterloo, Versailles, and Austerlitz; Parisian, Viennese, Mediterranean—all have deep overtones of meaning that have spread far beyond their map locations.

Mention the Niemen River and Tilsit, and a schoolboy will recall where Napoleon and Alexander I met on a raft to divide the world between them. Rouen and Domrémy were immortalized by Joan of Arc, and Cannae by Hannibal's virtual annihilation of a Roman Army of 70,000 men. From there he sent back to Carthage a bushel of gold rings snatched from the fingers of Roman knights.

At Lake Trasimene Hannibal ambushed his entire army, and destroyed most of the troops opposed to him. At Chalons-sur-Marne, Attila, the "scourge of God," was defeated by the allied Romano-Goths; Venice was founded on lagoon islands by refugees fleeing before the Huns.

Ramsgate was landing place of St. Augustine of Canterbury, who converted the English to Christianity, and another religious marker is Worms on the Rhine, famous for the Diet of 1521—and so the list might continue almost interminably.

CHEESES, CATTLE, AND CHEMICALS

Many places on the map have given names to articles in everyday use, and we are so familiar with these terms that we think seldom of their origin.

We walk on Brussels carpet, order Brussels sprouts from the grocer, and admire Brussels lace. A list of famous laces reads like a gazetteer: Alençon, Valenciennes, Chantilly, Venice, Mechlin, Antwerp, Binche, Cluny, Milan, Honiton, Lille, Arras, and Genoa.

It is the same with names of wines: Bordeaux, Burgundy, Malaga, Champagne, Sauterne, Rhine, Moselle. And then there are such modifications as Port, after Pôrto, in Portugal; Sherry, for Jerez, in Spain, and Tokay, for Tokaj, in Hungary.

A list of the Channel Islands suggests a program for a livestock show, what with Guernsey, Jersey, and Alderney.

Connoisseurs of cheeses can find most of their favorites roving the map: Cheddar and Cheshire; Stilton, Gouda, Edam; Gorgonzola, Roquefort, Camembert, Neufchâtel. Slightly changed are Parmesan, from Parma, in Italy; Gruyère from Gruyères, Switzerland, and Limburger from Limbourg Province, Belgium.

* Members wishing additional copies of the map, "Central Europe and the Mediterranean," may obtain them by writing the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen; INDEX, 25¢. Outside of U. S. and Possessions, 75¢ on paper; $1 on linen; index, 50¢. Postage prepaid.

Even the chemist can trace the labels on his shelves to labels on the map.

The element lutecium takes its name from Lutetia, as ancient Paris was known. It belongs to the ytterbium group of earths, named from a town, Ytterby, in Sweden. Three other chemical elements are named for this same town: erbium, terbium, and yttrium.

Indeed, the chemical list rivals that of the cheeses: europium; gallium for Gallia, Latin for France; magnesium for Magnesia, a district in ancient Greece; masurium for Masuria, in East Prussia; rhenium for the Rhine Province; ruthenium for Ruthenia; thulium for Thule (Northland), germanium for Germany, and scandium for Scandinavia.

Every major chapter in European history—the Norman Conquest, the Magna Carta, the Reformation, the Renaissance, the Industrial Revolution, the World War—all have touched America, as does the news of today.

NEW MAP IS NEWS SUMMARY

The new Europe map summarizes portentous developments of recent months.

Before the World War Europe had 11,000 miles of national boundary lines; after the peace treaties these were stretched to 17,000. Now they have shrunk again to 15,500.

Czechoslovakia, born in 1918, is missing from the 1939 map. It has gone to join Montenegro and other ghost countries of the past, its four provinces administered now by three governments. Two of these provinces, Bohemia and Moravia, are a protectorate of the German Reich; Slovakia is an independent state; and Ruthenia, renamed Carpatho-Ukraine, has been incorporated into the territory of Hungary.

These boundary changes entail changes in place names. In Bohemia and Moravia the old German names are again in vogue. Plzeň once more is Pilsen, and České Budějovice reverts to Budweis; while Slavkov again becomes Austerlitz, as it was known when Napoleon won his greatest victory there.

In Slovakia, because of its autonomy, place names remain the same, but in the Carpatho-Ukraine they become Hungarian. Chust, for instance, is replaced by Huszt.

In March, 1939, Lithuania restored the territory of Memel to Germany and that 1,100-square-mile area is shown on the new map with its new political coloring.

Albania, now wearing the map yellow of Italy, reflects its new political status in the renaming of Santi Quaranta, changed to Porto Edda, to honor the daughter of Premier Mussolini.

The ceding of the Hatay Republic by France to Turkey in June, 1939, increased the area of that country by nearly 2,000 square miles. This Republic, formerly part of the Levant States, was administered by France under a League of Nations mandate.

The change from French to Turkish administration also made necessary new place names. Antioch, scene of St. Paul's first ministry, is now Antakya, and Alexandretta becomes İskenderon.

Many new place names appear in Libia as the result of Italian colonization. Marconi and D'Annunzio are among them.

That part of the U. S. S. R. shown on the map represents an entirely new selection of place names based on the new Soviet Atlas and recent official Soviet maps. In the much discussed Ukraine, in the neighborhood of Stalino, appear in large type such new and important names as Makeevka, Ordzhonikidze, Gorlovka, and Sergo.

Limiting the new map to Central Europe increases the scale to permit 1,207 names within the area charted which did not appear on the Europe Map published April, 1938. Also, 173 places here shown have had their names officially changed within the eighteen months since the Europe map of last April.

MAP INDEX A GAZETTEER OF CHANGING PLACE NAMES

The index to your new map is of especial reference value because it not only lists all place names, but also gives cross references for important features whose national or historic spellings are different from those familiar to English-speaking users. The erstwhile capital of Czechoslovakia, for example, is listed three times: under *Praha,* the Czech spelling; *Prag,* the German one; and also under the familiar English one, *Prague.*

The New Map of Central Europe and the Mediterranean, which also contains contiguous areas of Asia and Africa, is drawn on a scale of 78.91 miles to 1 inch. It is the third of four important map supplements planned this year. When the fourth, that of Central America and the West Indies, appears in December, the National Geographic Society will have distributed in 1939 more than 4½ million large 10-color maps to its membership.

VOL. LXXVI, No. 5 WASHINGTON NOVEMBER, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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BUENOS AIRES: QUEEN OF THE RIVER OF SILVER

By Maynard Owen Williams

SNOWDRIFTS behind us, tropic seas ahead, we skirt Manhattan's mountainous silhouette, pay mental tribute to Liberty, and go rolling down to the Río de la Plata—the River of Silver—whose queen is Buenos Aires.

Once safely in the Southern Hemisphere, we entered Rio's majestic harbor, watched Santos pour coffee into yawning hatches, visited Montevideo's swarming beaches and lo! we were plowing the muddy waters of the Río de la Plata. Then journey's end as Buenos Aires, largest city in the Southern Hemisphere, grew against the flat, fertile land (map, page 565).

Skyscrapers notch the sky line, many ships line the busy docks, trim sailboats ride at anchor. This unimposing and hard-won site has become a center of restless energy, an enviable trade, and an enjoyable life.

Pleasant it is, this Argentine metropolis, and pleasant it intends to be. Having started as an ugly duckling, and glorified itself by sheer courage, talent, and determination, Buenos Aires is replacing antiquated warehouses with lush new parks and opening up wide traffic lanes through congested districts.

ONE OF EVERY THREE ARGENTINIANS LIVES IN THE CAPITAL

Once a mud-walled stockade which repelled the Indians but experienced famine, the city and its suburbs now house nearly three and a half million inhabitants, one person out of every three in the Republic. As former President Sarmiento said of a city a tenth its present size, "When Buenos Aires has a cold, the whole Republic sneezes."

Far-sighted men, seeking to curb its incongruous towers and govern its industrial fervor, point out that if Buenos Aires were to build up to the level now approved by law it could house 30,000,000 overcrowded citizens. Present efforts are to make it not bigger but better, not greater but greener.

Cartographers and heavenly bodies conspire to make the capital confusing to the stranger. Local maps, starting from the river, have east at the bottom and north at the right. The sun, swinging across the northern heavens, moves in a counterclockwise curve. Not the Big Dipper but the Southern Cross is the chief sky-mark.

Street names and statues outline the city's history. Juan Díaz de Solís, who discovered the Mar Dulce in 1515, is honored by a plaza in the Boca,* and Sebastian Gaboto, or Cabot, by a street.

Backed against a modern megalith suggesting ancient Egyptian art, Pedro de Mendoza stands with sword in hand, facing the city he founded in 1536 but could not hold. Not for many decades was Buenos Aires as populous as when his 50 grandees, 2,500 Spaniards, and 150 Germans stretched first their legs and then their famished bodies on this shore.

Facing the Casa Rosada, or Pink House (Color Plate VI), which stands where his fort was built, Don Juan de Garay surveys the site he chose when he came down from the refugee colony at Asunción to

* As the port on the Riachuelo is called.

Photograph by Maynard Owen Williams

AIR DRILLS BEAT A TATTOO FOR A SUPER HIGHWAY TO TIGRE

The Argentine Automobile Club maps the ambitious road-building scheme behind the workers. The new road will add another section to the network which centers in Buenos Aires.

refound Buenos Aires in 1580. The development graph since that time would cheer a pessimist. Three hundred inhabitants then; 46,000 in 1810; 305,000 in 1880; 2,463,269 on February 1, 1939.

THE TOMB OF A HERO

At the doors of Government House and beside his impressive tomb in the Cathedral, guards, wearing the uniform of the Grenadiers, keep alive the memory of San Martín (Plates VII and VIII).

The monument to this champion of Argentine, Chilean, and Peruvian independence is surrounded by fine old residences which house the Ministry of Foreign Affairs, the Military Club, and the National Parks Administration. Beside the Plaza Hotel is the Kavanagh Building whose penthouse apartments recently won the South American altitude record from the Palacio Salvo, diagonally across the river in Montevideo (Plates III and X).

In the Plaza San Martín nursemaids and children, lads and sweethearts, sailors and señoritas gather at twilight while the British clock tower glows and twinkling lights outline the harbor (page 569). Where the slave market and bull ring stood, soft slopes of greenery greet the foreign visitor or the hurried suburbanite.

In the Plaza de Mayo, historic center of urban life, a white obelisk bears the magic date, May 25, 1810. Like the July 4, 1776, which did much to inspire it, this was not the day of a military victory but of a Declaration of Independence, confirmed on July 9, 1816, by the Congress of Tucumán.

From this spot starts an avenue worthy of any metropolis, bright and shiny Diagonal Norte.

Photograph by Maynard Owen Williams

TALL APARTMENT HOUSES RISE, ROW ON ROW, WEST OF AVENIDA ALVEAR

Modernistic buildings, like "dressers with their drawers pulled out," are crowding out old houses and back gardens. Homes of the well-to-do are in the most thickly populated sections (page 576).

Although Buenos Aires covers more space than Paris, hurried visitors may see much.

They gaze at the Government House Grenadiers, colorful as the Horse Guards in Whitehall; note the obelisk of freedom; see the yellow Cabildo, before which independence was declared; enter the Cathedral to visit the tomb of San Martín, and hear how the pediment was done by an Italian prisoner in the Cabildo who thus earned his freedom.

Up the tree-lined Avenida de Mayo they ride to Congress Hall, where they hear a jangling alarm. When debates become overheated, this aid to legislative procedure engulfs the verbal fire in waves of sound.

Backstage at the Colón Theater, or Colón Opera House, which paid the top price for Caruso's top notes, the visitor imagines what a public place this would be for stage fright or sits in a box behind whose concealing grill conventional mourning, now shortened, observed the proprieties while the ear delighted in grand opera or the eye in a bright ballet.

Close to the Opera and twice as wide as the highway in the Champs Élysées in Paris is the Avenida 9 de Julio, whence one drives to the fashionable Calle Florida, closed to automobiles from four to eight in the evening (page 567). The pedestrian throng is colorful, spirited, and gay.

INCREASING INTEREST IN SPORT

Another attraction is the swift ride to that island recreation spot known as the "Tigre," with passing glances at the Palermo Parks; the two famous race tracks at Palermo and San Isidro; a few of the thirty-odd athletic clubs, emerald pools, and red tennis courts; the gray hulking stadium

Photograph by Maynard Owen Williams

HE RULES OVER TRAFFIC FROM A LOFTY, PARASOL-CAPPED PEDESTAL

Beside the busy Plaza de Mayo (page 562), the policeman takes his elevated stand, which gives him unobscured vision, even at the height of rush hours.

where 90,000 soccer fans watch a bounding ball, and enough cricket, golf, and polo fields to indicate young Argentine's increasing interest in sports.

A launch ride through the Paraná Delta evokes memories of the canals opposite Bangkok, and twilight tea on the Casino terrace, with white-clad girls in shorts rowing male ballast about and motorboats parading the river below, reminds one of the Thames at Maidenhead or Henley.

In the midsummer heat of Christmas morning, after the *Uruguay* left, I walked under massive magnolia trees to the old Pilar Church, whose windows are alabaster instead of glass.

Shiny motors rolled up and flower sellers provided armfuls of gladioluses, hydrangeas, or *estrellas federales* (poinsettias) with which to decorate the close-packed tombs of the Recoleta Cemetery. The last flower, red, as was the ink of his documents, keeps the memory of Rosas alive among those by whom his memory is most hated (Plate VIII).

A LUXURIOUS CEMETERY

Here wealth, genius, and political power are memorialized in family mausoleums which stand on soil costing $1,000 a square yard (page 569). The bodies lie in tiers, with the richly carved coffin of the father and mother in the main chapel and other members of the family in the vault where fresh flowers glow in the light of tiny lamps.

The gray-suited, straw-hatted guardians are ever at work, washing vases, arranging bouquets, polishing brasswork. All day long there is a procession of relatives bringing new floral offerings.

Children toddle along. Aristocratic señoritas come in bright dresses, once barred from church and cemetery. Men bare heads to the summer sun.

Early in the afternoon the Recoleta is almost deserted. The guards, who look to Americans like farm hands in their straw hats, snooze in the cypress shade or gossip near the ship-topped shaft of Admiral Guillermo Brown, "father of the Argentine Navy," beside Falguière's eloquent figure of Life protesting at the call of death, or Father Time's patient survey of the sand in a monumental hourglass.

However, on Christmas morning the Recoleta is less a place of gloom than welcome rendezvous with loved ones who are not forgotten in death.

Plans are afoot to make the dead help the living. Because of the high price of grave plots, the street to the north could be sold for enough to buy a triangle of buildings and turn their sites into a rolling green connecting upper Pueyrredón with the riverside parks.

The manager of my hotel, long a National Geographic Society member, took a keen interest in my work.

"Buildings? A skyscraper is the same as in New York, only the New York ones

Drawn by Ralph E. McAleer

ARGENTINE LIFE RADIATES FROM BUENOS AIRES, HEART OF THE NATION

The giant largest city in South America sprawls over the flat pampas at the vast estuary of the Río de la Plata. Through its harbor and the port of its near-by sister city, La Plata, passes the bulk of the trade of Argentina's wealthy northern and western provinces. Situated about as far south of the Equator as Atlanta, Georgia, lies to the north, Buenos Aires experiences winter weather in June, July, and August; summer temperatures in December, January, and February.

Photograph by Luis Marden

"GAUCHO" TROUPERS PERFECT THEIR TANGO IN PALERMO PARK

Members of a theatrical group from a café in the Avenida de Mayo rehearse to the tune of an accordion (page 585). The baggy trousers of the men are modern cowboy attire.

Photograph by Maynard Owen Williams

MIGHTY STEAMERS CAN ENTER BUENOS AIRES DOCKING BASINS BECAUSE THIS HUMBLE DREDGE IS NEVER IDLE

The elaborate docks are built from mud flats. Constant operations by a fleet of these powerful work boats keep the channel open and permit easy berthing of transatlantic liners in the Río de la Plata, close to the heart of the city. The old harbor to the south (Plate V) is the center of Buenos Aires manufacturing (page 574).

Photograph by Maynard Owen Williams

FROM BROAD DIAGONAL NORTE PROMENADERS CONVERGE INTO NARROW, BUT GAY, FLORIDA

The official name of the wide thoroughfare is Avenida Roque Sáenz Peña, after the Argentine statesman who was President from 1910 to 1914. The sculptured group, center, is a memorial to him. Florida, only 10 blocks long and about 20 feet wide, is a historic street, as much a favorite with merrymakers as Broadway in New York or the boulevards in Paris. From 4 p. m. to 8 p. m. it is closed to all vehicles (pages 562-3).

© Charles d'Emery

CARS PARK UNDER THE SWIMMING POOL IN MAR DEL PLATA, "NEWPORT" OF BUENOS AIRES

The modern summer resort, on the Atlantic Ocean 250 miles south of Argentina's capital, was begun as a real estate venture in 1874. Until then it consisted only of a few cottages. Today nearly a quarter of a million people may be found here at the height of the season, enjoying the bathing and gathering about roulette tables. Hundreds of "bathhouses" dot the beaches. So crowded is the resort at Carnival time that many celebrants from the capital use their railway sleeping cars for a hotel.

Photograph by Alfred T. Palmer

STATUES SURMOUNT THE MAUSOLEUMS OF RECOLETA CEMETERY

Peculiarly Argentine is this burial ground in Palermo Park, where bodies lie in tiers (page 564). They are encased in leaden shells, placed within coffins of carved wood, and these in turn repose on shelves in the stone memorials.

Photograph by Maynard Owen Williams

BOON TO COMMUTERS IS THE BRITISH CLOCK TOWER

Standing in Plaza Británica opposite the Central Argentine Railway Station, the 207-foot tower was presented to Buenos Aires by British residents in 1916. The Kavanagh skyscraper apartment house rises in the background (Plate X).

Photograph by Luis Marden

TRADITIONAL TOP-HATTED CHIMNEY SWEEPS SPEED TO WORK ON A MOTORCYCLE

Most of the de-sooters in Buenos Aires are of German descent. Their tightly buttoned uniforms are adaptations of old German sweeps' attire. Once there were many members of the profession in Argentina's capital, but modern building has caused a rapid decline in their numbers (page 571).

Photograph by Alfred T. Palmer

"PEANUTS! PEANUTS!"

Although the roaster is concealed in an imitation locomotive to attract attention, a foreigner in Buenos Aires knows what the vender offers for sale, even without understanding his cries (page 571). The aroma of roasting goobers is unmistakable.

Photograph by S. Sato

NEW YEAR'S EVE CELEBRANTS DON "SUMMER FORMALS" IN BUENOS AIRES

A jazz band plays out the old year for dancers at the Alvear Palace Hotel. The photograph was made especially for THE GEOGRAPHIC by order of the proprietor of the hotel, a long-time member of the National Geographic Society.

scrape deeper. People? You can't tell a man on the Avenida from one on the Avenue. But there are a few of the old types left and if you don't get them now you never will.

CHIMNEY SWEEPS AND PEANUT VENDERS

"First, there is the chimney sweep, wearing a high silk hat and riding a bicycle. Then there are the Basque milkman and the Basque market porter in berets.

"Although hot peanuts aren't in demand in summer, you may find a peanut vender, whose 'Maní' you know from the song. His roaster is built like a locomotive, so they call him a 'ferroviario' " (page 570).

"I saw one in the Retiro district last night," I replied. "I'll get him today."

He was not there. But ultimately Marden and I completed the series. As he left after photographing a chimney sweep, two more sped by on a motorcycle. The bird in hand seemed less worthy than these two, so my GEOGRAPHIC colleague started in hot pursuit and got his men (page 570).

Picture hunting in Buenos Aires demands as much patience as ostrich hunting on the great ranches. There the old families escape city crowds and rusticate amid herds of cattle, linseed threshers, and gauchos on *criollo* horses, descendants of barbs imported by Mendoza.

As guests of Spanish friends, Marden and I rode out to visit one of these delightful retreats, to savor a barbecue and see wild ostriches outpace hard-riding herdsmen with lasso and *boleadoras* (Plate XI).

The simple house, with its row of bedrooms along a porch leading to the dining room, has hardly been changed in seventy

Photograph by Maynard Owen Williams

FOOD FOR THE HUNGRY PRESSES OF BUENOS AIRES NEWSPAPERS

Giant rolls of paper, loaded on a truck at shipside, come in from Finland, duty free. Their destination is the pressroom of *La Prensa,* one of the city's internationally known papers. Other large dailies are *La Nación,* and the tabloid, *El Mundo* (pages 573 and 576).

years. Dusty account books still reveal the transactions of a century ago. The showers are modern, but the lights beside the big mirrors are tallow candles.

Formal gardens of aromatic box overlook a lake which would be paradise for a naturalist because of the variety of birds which swarm here at nightfall.

A barbecue is something to write home about, for the ceremony gives one a sense of primitive life in the "camp." The animal, in this case a young lamb, is split open, put on a swordlike spit, and tilted toward a slow fire. After hours of distant roasting, the meat is indescribably delicious.

THE GAY NINETIES—AND TENDER STEAK

After lunch the gauchos brought down an ostrich with the *boleadoras*—whirling balls joined by cords (pages 590-1).

As we walked in the garden with our host and hostess, their joy in the trees and boxwood had a Shakespearean poetry about it—"And this our life, exempt from public haunt."

Back in Buenos Aires, gilded youths were sipping cocktails in front of gallant frescoes of the naughty nineties with the "bicycle built for two," the cross-gartered bathing girl, and gay blades with handlebar mustaches, paintings showing the antique market place and Cabildo and in virile frescoes the stern strength and beauty of the gaucho and the Indian, the llama and the cactus. Sophisticated art, indeed, the work of these ranch dwellers whose chief delight is to walk at twilight along century-old alleys of box under tall trees, with the dogs about and a sturdy criollo horse whinnying for attention.

With the general manager of one of the large packing houses I rode down to La Plata (page 589).

After two hours of watching the many varied operations of a modern plant, we thoroughly enjoyed such a steak as few are favored to see, much less taste. "Too

Photograph by Luis Marden

CUSTOMERS BUY SOME OF HIS WARES FOR A SONG

The bird vender wheels his cargo in front of the Alvear Palace Hotel. Native cardinals, imported canaries, and Australian parakeets make up most of his stock. Comparatively few songbirds inhabit the gardens of Buenos Aires. They prefer the wild forests and marshes, away from man.

few," say the Argentine cattlemen, who pity our underfed millionaires.

Nor are they entirely blind in their prejudice. What astonishes one is not the cleanliness of the Bulgarian or Czech workers or the care of government inspectors, but the diversity of by-products in a modern packing plant.

Ranging from bone meal to gland extracts, they enable meat from distant ranches to be sold at a reasonable price. The preparation and utilization of the by-products demand large-scale handling and highly efficient methods, which in turn involve a heavy overhead.

Against that overhead, be it in Buenos Aires or Chicago, the packer must constantly fight. If production lags, the overhead does not fall in the same proportion. If more meat is sold the overhead per pound is reduced.

The solution, according to packers, is "Eat more meat," to which others, from Battle Creek to Bernard Shaw, reply "Eat less."

Such juicy steaks as I had at La Plata render an unprejudiced decision impossible. As long as I can get a thick slab of delicious tenderloin with mushrooms for 35 cents, I'm not fit to be a judge.

HOW TO LIVE 24 HOURS A DAY!

Señor José Anesi, who proudly boasts that he got his inspiration from THE GEOGRAPHIC, edits the *Revista Geográfica Americana*. As a long-time member of our Society, he gave me ideas for a nocturnal prowl. We had spent the early evening—from 12 to 2—watching *La Prensa's* huge presses cover paper from Finland (page 572) with news from all the world and were walking past the city's most original monument—the Song of Toil.

I had been up and about for 19 hours. So, doubtless, had he. But the thrill of the city's life by night touched us both.

"At three, you should see the newspaper market in the Avenida de Mayo. At four, the railway platforms at Retiro look like

Photograph by Alfred T. Palmer

FREIGHTERS LOAD BULGING CARGOES AT THE OLD PORT ALONG THE RIACHUELO

Heavy draft horses still pull rumbling drays over the cobblestone quays at the southern end of Buenos Aires. Passenger steamers dock farther north (Plate V and pages 566 and 588).

a flower-blanketed funeral, a block long. At five, the gauchos are driving cattle into the stockyards at Nueva Chicago. At six, the port wakes up. Seven is busy enough, but the suburban clerks, stenographers, and business men won't come pouring in until eight or half past. After that, you won't miss anything but lunch if you sleep till four."

Buenos Aires' energy is traditional.

The early settlers did not squat beside deep water and let their city float in as ballast or cargo. There was only a shallow river on whose muddy bottom a truant lad could have walked out of sight without going over his head (page 566).

Having tamed the river to its use and dredged broad basins with 26 feet of water in them where a dugout canoe would once have grounded, Buenos Aires was able to influence shipbuilders half a world away.

Even the Suez Canal makes its dredges squeal under the tyranny of broader beams and deeper keels. Buenos Aires uses its coveted trade as a spur to marine architects everywhere. There the city stands, exporting meat and grain from the spot where Mendoza's grandees starved. Behind the flash of windshields I often imagined the morions and breastplates of Mendoza's pioneers.

WINDS, NOT TIDES, AFFECT SHIPPING

Though Buenos Aires stands not so much on a river bank as on an arm of the Atlantic, the tide is negligible. What really changes the water level is the wind. Even during my visit heavy steamers canted over in the mud. At times the deep-set waterworks pumps have run dry and thirsty folk have dipped water out of the city's fountains. When a downstream wind combines with the current, the Río de la Plata looks like a well-watered course for a race to Uruguay between Pharaoh's chariots and the Israelites.

Old prints by Emeric Vidal and Ibarra show women doing laundry where big steamers now berth, and Luna Park prize fighters buffet each other where the laundresses paddled soiled clothes. Not until 1855 could passengers land on a mole which looked like an amusement pier, and men now living remember the high-wheeled carts in which travelers were carried from small boats to the shore.

Photograph by Alfred T. Palmer

LLAMA-BACK RIDES ENTHRALL YOUNGSTERS AT THE BUENOS AIRES ZOO

Some of these South American "camels" with a few of their larger brothers, the guanacos, came to the National Zoological Park in Washington recently. Dr. William Mann, director of the Park, while in Buenos Aires with a small stock of bison, Texas red wolves, eagles, and raccoons, negotiated a trade with the Argentine zoo.

I never tired of roaming the port, dodging crude-shaped bundles of smelly hides, watching the half-ton wool bales bounce, seeing golden corn being inspected by men with tubular spears like cheese testers, pondering on what world news would blacken the pages of those giant cylinders of print paper, seeing Tricolor and Swastika flags flutter side by side, or catching a sentence in Arabic where a Syrian from the Reconquista chatted with a deck hand from Aden.

HERE COME THE WORLD'S GOODS

Here came bananas, oranges, and pineapples from Brazil. There American motorcars were being dropped overboard to touch Argentine soil before import restrictions became effective.

Twilight fell as Japanese chambermaids came down to pick up bright pebbles dropped from a gravel truck and blond Teutons gazed on this great city where Germany barters for food.

The passenger liners of Italy and Germany were years a-building. Here is the 30,417-ton *Augustus,* 16 days out of Genoa, or the trim *Neptunia,* two weeks from Gibraltar.

Germany's pride is the *Cap Arcona,* 27,560 tons, 17 days from Hamburg, a fortnight from Lisbon. The French ship *Massilia* makes the 6,150 statute miles from the Tagus in a day less. Our own ships, the 18,000-ton *Argentina, Brazil,* and *Uruguay,* take 18 days from New York.

Our passenger service to the east coast of South America is much improved and bookings are heavy. The accommodations are luxurious, the food of the best, the service excellent. There are plans for faster ships of lighter draft to bind the Americas more closely, although we have fewer family ties than Argentina's large European population.

Many a liner on the River Plate flies the Union Jack. With 3,750,000 tons against Germany's 931,000, Britannia pretty well rules the coffee-colored waves of the River of Silver.

With only 12,760,000 inhabitants, whose per-capita income is high, Argentina is the

world's largest exporter of corn and beef, sometimes ships more wheat than Canada, and exports enough mutton to rival New Zealand.

Looking down on Argentina's lush alfalfa fields, a returning airplane passenger says, "Put a bit of salt and vinegar on it and you could eat it yourself."

From my window on the Avenida Alvear I can look down on the back gardens of Renaissance homes, gabled and turreted like castles in Touraine, some heavily decorated by imitators of Jean Goujon. Within are rooms that are seldom used, huge copper bathtubs set in hand-rubbed wood, marble Venuses hiding under broad, sweeping stairways.

But crowding in on these green gardens are modernistic apartment houses, like "dressers with their drawers pulled out," designed to hold as many people as decency and comfort allow (page 563).

Marble Venuses are replaced by bright bowls of fresh flowers, reflected in amber mirrors and black-glass tiles, and the tenants change almost as often as the flowers.

Leisurely old Buenos Aires, with its palm-filled observatories and quiet gardens, is piling up and filling in.

The most thickly populated sections of Buenos Aires are occupied by the well-to-do. Partly because of swampy terrain, and partly because of one-story construction, the working class quarter, between the Nueva Pompeya and Liniers sections, contains only one-tenth of the urban population. Behind Congress Hall the density of population is nearly ten times as great.

The Recoleta section, for all its parks and spacious old mansions, now invaded by interior decorators, dressmakers, hat and flower shops, has more inhabitants to the acre than the Boca district, once a byword for its moral, as well as its physical, odor.

City planners now fight for breathing spaces for tired mothers and playgrounds for restless children. Not monuments but men are their goal. And even the casual visitor soon realizes that its citizens, even more than its parks, are the chief charm of the Argentine capital.

A Scotsman sits in the City Council; an Englishman with an Oxford accent says "We"; an Italian drops a letter from his name to conform to Spanish spelling; a Spaniard orders a "Criollo" (native) dainty; an Irishman tells of the death from yellow fever, in 1871, of Father Anthony D. Fahy, beloved member of the Irish community. All of them are proud *porteños*—citizens of Buenos Aires.

This cosmopolitan quality of the people gives Buenos Aires its distinction. Proud of his city, the porteño is served by many lands. His car is American, his woolens and pipe British, his watch Swiss, his camera German. He prefers American movies, Italian ravioli, French neckties, and Japanese silk shirts. In his American motorboat he has a German motor and a Dutch radio.

His defense of such cosmopolite tastes is that he is an Argentino, with the world's goods, cultures, and philosophies to choose from, and that he would be a fool to restrict his power of choice.

Not only is he served by a native press, including such world-famous sheets as *La Prensa* and *La Nación* or the highly popular tabloid *El Mundo,* but he buys many foreign journals and books. A newsstand or library table in Buenos Aires is as cosmopolitan as the harbor.

Among the city's many scattered libraries my favorite haunt was that of the Jockey Club, on whose table THE GEOGRAPHIC was grouped with the *Revue des Deux Mondes, Das Innere Reich, Le Vie del Mondo, The London Mercury, Present-day Nippon, The Saturday Evening Post,* and many another.

I dare not give the name of one of my best friends in Buenos Aires, a Kilmarnock Scotsman, lest his fellow members in the United States invade his old-fashioned high-ceilinged office in a former presidential palace and impose upon him—as I did myself.

PARK BENCHES FOR READING

After his clerk had brought in a pile of GEOGRAPHICS with white slips of paper marking my articles (you don't put much over on the Scots), we went places and saw things—the Jockey Club, where he got me a much-envied guest ticket and a badge for the San Isidro races; the Navy and Military clubs; the Gas tearoom, so named because it was the first in Buenos Aires to imitate Paris, then the gas-jetted "City of Light"; the tower of the City Council Building; and finally a huge tree near the Colón Theater which he saved from destruction. He had passed me free into the subway he helped build (page 587), and into many exclusive spots, but what he

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IN 80 DAYS BUENOS AIRES CREATED BROAD PLAZA DEL CONGRESO

Four blocks of five- and six-story buildings were razed, a lake created, walks laid out, and trees and lawns planted, to complete a park in time for the centennial celebration, in 1910, of the Argentine Declaration of Independence. Upon the memorial to liberty falls the shadow of Congress Hall (Plate XIV). Avenida de Mayo, the capital's "Gay White Way," leads out from the eastern end of the plaza (background).

© National Geographic Society Kodachrome by W. Robert Moore

THE AUTHOR AS KING NEPTUNE, WITH A BRAZILIAN "QUEEN"

Kodachrome by Maynard Owen Williams

S. S. "URUGUAY" PLOWS THE BLUE CARIBBEAN ON HER WAY SOUTH

© National Geographic Society

Kodachrome by Maynard Owen Williams

BUENOS AIRES' CHICAGO-LIKE SKYLINE LOOMS ON THE HORIZON AS THE "URUGUAY" NEARS THE NORTH BASIN

The pilot boat has escorted the steamer up the channel of the broad Río de la Plata. Soaring above all other buildings in the city is the 28-story Kavanagh apartment house (Plate X). Small boats at left cluster about the Yacht Club, beyond which (extreme left) rise towers of the Customhouse.

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Kodachrome by Luis Marden

WITHOUT WARNING, SUDDEN WINDS MAY DRIVE BREAKERS TO THE TOP OF THE STEPS, SENDING BATHERS SCURRYING

Lifeguards keep Buenos Aires swimmers at Municipal Beach reasonably close to the shore because of this danger. So shallow is the water that venturesome spirits, if they were permitted, could wade out almost to the dredges and tugs in the background, some four miles away. Tides are not strong this far up the Río de la Plata. On pleasant days beach crowds exceed 15,000. Admission costs only two and a half cents.

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Kodachrome by Luis Marden

ON THE BANKS OF RIACHUELO RISES ARGENTINA'S GREATEST INDUSTRIAL CENTER

The stream separates Buenos Aires (right) from the rapidly growing manufacturing city of Avellaneda to the south. The photograph was made from the top of a swing bridge overlooking the old original port. In the last 80 years Buenos Aires has extended its harbor far north of this point, creating out of mud flats one of the world's largest dock systems.

© National Geographic Society

Kodachrome by Luis Marden

FROM PLAZA DE MAYO, HEART OF BUENOS AIRES, CITY AND SUBURBS RADIATE IN A SEMICIRCLE

In the center of the park stands the "Pirámide de Mayo," commemorating Argentine independence. The Presidential Palace, facing the memorial, is known as "La Casa Rosada" because it is painted rose color. Beyond the building huge grain elevators rise along the Río de la Plata docks. At right stands the new Ministry of Finance building and, at left, the Bank of the Nation.

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ESKIMO PIE IS A "SMAK" IN BUENOS AIRES

Uniformed salesmen with little red carts are everywhere. Frozen bars, sold by the millions annually, are two and a half cents each. Cardboard cups of ice cream are five cents.

Kodachrome by Luis Marden

HISTORIC UNIFORMS GARB PALACE GUARDS

They wear the dress of the Mounted Grenadiers, favorite troops of José de San Martín, South American hero who helped Argentina, Chile, and Peru gain independence (Plate VIII).

THROUGH SILVER TUBES, NOT STRAWS, THEY SIP THEIR HERB TEA

The hot, aromatic maté is not usually sold in restaurants, but is brewed in the home or on picnics. The gourd container also is called a "maté" (Plate XI).

© National Geographic Society

Kodachromes by Luis Marden

HAND-TOOLED LEATHER ENCASES HISTORIC DEEDS OF TYRANT AND HERO

Constant warfare marked the dictatorship of Juan Manuel de Rosas from 1835 to 1852. To José de San Martín, co-hero with Simón Bolívar, Argentina gives principal credit for gaining the Nation's freedom from Spain.

seemed most proud of was that widespreading tree in the heart of Buenos Aires.

Hidden away in Lezama Park, which a beloved philanthropist bequeathed to the city where he won his wealth, another tree, its outthrust roots polished by many youthful feet, furnishes shade for one of the most charming of Buenos Aires institutions—a tiny branch library for park-loving readers.

Around this kiosk, under this great tree, the benches are reserved for patrons of this free library. "Silence" is the unwritten rule, and he who rests must read.

There are 1,527 National Geographic Society members in Buenos Aires, and scanning their names gives one a graphic idea of the many lands from which our fellow members, or their ancestors, came to the Argentine.

The eclectic quality of Argentine thought is also reflected in its funny papers. "Humorismo Español, Italiano, Francés, Alemán, Inglés, y Yankee," each has its own page showing the comparative anatomy of international wit.

An English tearoom; Viennese coffee shop; a German saloon; Chinese, Russian, and Italian restaurants; a Parisian cabaret; Spanish and Syrian grocery stores; a Swiss pharmacy; an Indian rug store; a Turkish silk store; a Japanese dry-cleaning shop; a Polish newspaper office; Jewish theater, and Greek Orthodox church—all normal ventures in Argentine city life.

"POPEYE" AND "BETTY BOOP" POPULAR

Not only the English-language *Herald* and *Standard* but also the Argentine newspapers carry comic strips. "Mutt and Jeff," "Henry," and "Barney Google" are as well known on Rivadavia as in Times Square. Soglow's pompous "Little King" amuses Italian-Argentinians. Buenos Aires movie fans never tire of Popeye's perennial proof of the virtues of spinach or Betty Boop's ball-bearing eyes and hips. Donald Duck and Mickey Mouse are uncrowned kings of the River of Silver.

German radio dominates the short-wave field, but the average Argentinian, as does the average American, listens to local programs, supported by advertising. "Commercials" are restricted to 100 words every three minutes and politics are completely barred. More than a million radio sets comb the Argentine ether, principally for music rather than thought.

In 1829, Samuel Haigh wrote: "The gentlemen of Buenos Ayres dress as well as those of the same class either in London or Paris," a statement which still holds.

The key to the porteño's character seems to be that he thinks of himself as a gentleman. His cordiality and resentment at being forced or hurried; his frankness and sensitiveness spring from the fact that he considers himself a man of honor, jealous of his good name, and would like to have you share that opinion. Since the international character of his circle of friends makes for tact, lack of it is the more noticeable.

Haigh also looked on the señorita and found her good, with "a very small foot and a neatly turned ankle."

Seeing a young man alone may still be difficult and dueña days still leave their mark, but the rake of the señorita's hat suggests independence, awareness, and daring.

TANGO THE "NATIONAL DANCE"

Despite the innovations sought by society youths, the tango is the most popular dance in Buenos Aires. And the place to see it is on the Costanera Drive, a mile-long concrete dance floor served by municipal radio through a series of loudspeakers. On hot nights the wide promenade is crowded. Motorcars, their war cries hushed, creep along in Indian file, painted clowns crack wordy jokes, and Coney Island thrill rides squeeze squeals of pleasure from their patrons.

Here are thousands of happy folk enjoying the promenade or a balustrade to lean on, while the rising moon does give a silver touch to the brown river. But the main event is the tango and the main tango "La Morocha" or "La Cumparsita."

After 22 years the world-famous work of Gerardo Matos Rodríguez brings "Ahs" from the crowd. Marden, a keen tango taster, sought out the composer of what has been facetiously called the "National Anthem of Argentina."

As a student in Montevideo, Señor Matos Rodríguez was a member of a jolly group who called themselves "La Cumparsita," the Mummers. He sold the composition outright and his only royalties now come from words he wrote to replace the original ones.

In the southern flats near the Stygian Riachuelo there formerly lived tough citi-

Photograph by Luis Marden

PARKING IS FREE IN THE UNDERGROUND GARAGES OF AVENIDA 9 DE JULIO

When the Buenos Aires suburban resident drives in to his office in the morning, in this section of the city, he merely passes below the street level and backs his car into one of the stalls between the columns, out of the driving lane. This subterranean parking lot, one of two along the avenue, has a capacity of 600 automobiles (page 587).

zens who, from their swampy surroundings, got the dread name of "Frogs" (pages 565 and 588). This unsavory region is still pointed out as the birthplace of the tango, a dance whose style was fashioned by gaucho boots.

With such an ancestry the tango was ignored by the polite society of Buenos Aires, now devoted to the thigh-slapping of the Lambeth Walk and the chorus-girl strides of "You Can't Marry Ten Pretty Girls." But it emigrated to Paris, stalked across shiny floors there, and came home to Buenos Aires, changed but improved, like a sweet girl graduate, by its sojourn in France.

GAUCHOS—IN THE MOVIES

Gauchos, with their wide trousers, silver-studded belt, and tinkling spurs, are about as common on the Diagonal Norte as Indians on Broadway (page 590). The height of naïveté would be to mention "gaucho" to the man on Corrientes as he takes his señora to see "The Cowboy and the Lady" at an air-conditioned theater.

But the gaucho has been a challenging figure since the days when Darwin described his splendid horsemanship.*

To know the heart and feelings of this figure of the Pampa, variously described as the son of a white father and an Indian mother, or merely as a country bumpkin, one must read the epic poem *Martín Fierro* by José Hernández.

When Luis Marden dropped in by air from São Paulo, he demanded gauchos. Luckily I could fill the order, for on the Avenida de Mayo, where Argentines from the provinces have their hotels, sip their coffee, and savor urban life, I had spotted a gaucho troupe in a humble cafe.

The next day we matched *bandoneón* (which somewhat resembles a concertina) and soft boots with camera bellows and tripod leg before an admiring throng.

To help out local color, my colleague of the lens sought brightly decorated gourds (matés) and silver bombillas, or tubes, to show how yerba maté is drunk.

This delicious and stimulating brew from

* See "Life on the Argentine Pampa," by Frederick Simpich, NATIONAL GEOGRAPHIC MAGAZINE, October, 1933.

Photograph by Luis Marden

"CHADOPYF," BUENOS AIRES CALLS ITS NEWEST SUBWAY

The peculiar name comes from the initials of the managing corporation, just as New York City knows two of its subways by the names of "IRT" and "BMT." Scenes painted over entrances and exits are lighted in soft tones of harmonizing colors. "Salida" means "exit." "Plaza Italia," where the Zoo is located, is the destination of the train.

the leaves of the *Ilex paraguayensis* has the reputation of providing such vitamins as are lacking even in the juiciest steaks, but maté is not generally obtainable in the city's cafés.

Herb tea, compressed into burlap cylinders which look like gun charges for heavy artillery, commands a wide sale and the visitor who escapes without taking a silver "straw" and a gourd bearing the clasped hands and Phrygian liberty cap of the Argentine coat-of-arms is a rarity. Maté drinking, as virtuous as deep breathing, is usually as secret as a vice. But motorcars, facilitating the transport of maté equipment, enable one to see it at picnics.

HERE TRAFFIC IS A PROBLEM, TOO

Of the 265,000 motorcars in the Argentine Republic, more than 90 per cent were made in the United States, but Argentina produces more than half of its own oil.

Gasoline is cheap, about 18 cents a gallon, so when the Argentine goes for a spin he doesn't count the cylinders or spare the gas. His tires bear the familiar "Industria Argentina" label which is found on many products from textiles to perfume, beer, and plastics.

Traffic in Buenos Aires is hectic. Whoever gets his fender in first has the right of way. The local jitneys, which carry one-fourth of all traffic, dash about with their hoods raised like the wings of a setting hen.

Buenos Aires is making a serious attempt to provide parking places without occupying space on or above the street. Theaters and apartment houses are encouraged to provide basement parking despite the confusion of driving across the sidewalk at rush hours.

Under the Avenida 9 de Julio, which its planner points out to be not only the widest but the most necessary of avenues, there are already underground parking spaces, amply accessible over wide, easy ramps, for a thousand cars (page 586).

As the avenue is extended, this capacity may be trebled and opera- and theater-goers, leaving the Colón and Cervantes Theaters, will be whisked home before fashion pirates can copy their clothes.

I drove north along the new Costanera Drive, past powerful light plants whose feet

Photograph by Luis Marden

NEAR BUSTLING DOCKS OF THE BOCA, THE TANGO WAS BORN

A few decades ago, before industry invaded these southern flats along the Riachuelo, the famous Argentine dance originated in dance halls here. Polite society in Buenos Aires ignored the tango, but it went to Paris, then came back to its native city, and today is the most popular dance in the capital (page 585).

Photograph by Arthur Bauer

FROM AN ARMOUR PACKING PLANT AT LA PLATA, JUICY ARGENTINE BEEFSTEAKS GO TO SEA

United States and British capital are heavily invested in the Nation's meat industry. This packing plant, 30 miles from Buenos Aires, is one of a dozen which handles the bulk of stock raised on the broad pampas. Agricultural surveys put the number of cattle in Argentina at 35,000,000 head. Most popular breeds are Shorthorn, Hereford, and Aberdeen Angus (pages 572-3).

Photograph by Luis Marden

WHIRLING HIS BOLEADORAS, A MODERN "GAUCHO" CHARGES DOWN ON A FLEET OSTRICH

When the cowboy lets fly, his aim must be perfect to trip his quarry (Plate XI). He is roping the bird for sport (page 591). The South American ostrich, or rhea, is not as valuable as its Arabian or African relatives and its inferior plumes usually adorn only feather dusters.

are set in coal ports, toward the splendid waterworks.

An early writer says, "The waters of the River Plate, when drunk by Europeans, are in many cases fatal." Oxcarts went far out into the stream and brought back water which cost a cent a gallon, delivered to the door. Today, thanks to its efficient filtration plant, the purity of Buenos Aires water is admitted even by the wine waiters in the best hotels.

The concrete "boardwalk" is being pushed ahead and the day may not be far distant when promenaders, cyclists, roller skaters, and tango teams can disport themselves along the river front all the way from La Plata to the Paraná Delta.

One of the anomalies of Buenos Aires is the Barranca overlooking the river, a section of the bluff which parallels the Paraná and the Río de la Plata for hundreds of miles.

In a land so flat that even the water finds difficulty in running downhill, Buenos Aires has several streets so steep that only a powerful automobile can climb them in high gear and streetcars slam on their brakes as they go over the crest.

High buildings mask this steep bank, but Lezama Park owes much of its beauty to its high position above the Riachuelo. The green between the San Martín and Canning monuments has a noble slope to it; the hillside park at Belgrano is the pride of that fashionable section. At Olivos and San Isidro, once reached by chairs or coaches, the edge of this noble undulation in an otherwise featureless landscape was utilized as the site for a long row of country houses before whose doors wide lawns with formal gardens, shady branches, and crouching Venuses stretched down toward weedy pools at the river's edge.

Still farther upstream, the waters of the

Photograph by Luis Marden

TIGHT AS A SAILOR'S KNOT, THE BOLEADORAS TIE UP AN OSTRICH

When the whirling balls (page 590), wrapped the rope around the legs of the bird, its swift race came to an abrupt halt in a cloud of dust. On the ranch where the photographs of chase and capture were made, the birds are protected by the owner, an Argentine painter. They repay his kindness by destroying myriad locusts.

Paraná de las Palmas are joined to those of the Luján, the Tigre, and the Río de la Plata by a network of streams and canals on which trim motorboats carry the rich to their summer homes and well-filled launches chug humbler folk to a score of al fresco restaurants and playgrounds.

VENICE OF THE SOUTHERN CROSS

Rowing clubs are here, with canoes whose occupants swing a rudder with their feet to compensate for the thrust of their paddles. Slender shells skeeter-bug along and heavy barges of lumber or fruit proceed to market.

Fruit and vegetables in quantity come from the Delta orchards and gardens. January and March are the busy months, with lemons, plums, peaches, pears, and quinces the major items.

There is a plan on foot to colonize a portion of the Delta with farmers from the Netherlands, such workers as tamed Kalamazoo's black muck to celery growing.

It might not be necessary to wait for the Netherlanders, for in Buenos Aires there are many who like nothing better than to feel black muck squdging up between their bare toes.

They are the ones who go "camping," a disorderly and unbelievably enjoyable procedure which consists of bogging down a child-draped motorcar in mud, decorating its level surfaces with the more common types of food, stretching a sway-backed canvas from tree to tree, and leading a backwoods life on the urban threshold.

One of my favorite luncheon spots is the Zoo. During the noon hour the gates are closed, but anyone already inside is privileged to stay for lunch.

In the midday quiet the pelicans cease scraping the pool walls with side-turned beaks, give one great yawn, and pillow their huge pouches on soft breasts.

The capybaras, with the bodies of hogs and the heads of guinea pigs, loll in the dust and grunt. Storks, standing on one leg, fix the visitor with a one-eyed stare.

The zebras seek the shade; the hippos submerge; a jealous llama blows his nose at a rutting rival; the flamingos rest; heavy-bodied Patagonian hares stretch out their delicate legs on the cool grass; the ostriches cease their begging.

Jumbo and his mate withdraw into their Hindu temple, and a solitary penguin waddles past, exuding dignity despite his comical gait. Swan and goose, parrot and condor, tiger, bear, and lion cease their posing and welcome this hour of peace.

BUENOS AIRES, LIKE WASHINGTON, D. C., IS A CITY OF MANY TREES

Nor should it be forgotten that none of the city's trees is native to this soil. All were planted here. Buenos Aires thinks nothing of tossing full-grown trees about and verdant plazas follow obsolete or encumbering buildings so fast that the dust of demolition just misses the verdure which follows.

In 1936 nearly 10 million square yards of parks, plazas, and playgrounds were opened, an area nearly half as extensive as that of the city's paved streets.

In four years 88,000 trees were planted —enough to shade both sidewalks for 80 miles. Sometimes a change of parties wipes out trees. The monument to Bernardino Rivadavia, first President of the Republic, at the Plaza Once de Septiembre, rises from a bare gravel plot, once a rose arbor.

Across the Avenida Las Heras from the Zoo are the Botanic Gardens, which Lord Bryce found of the "highest interest."

More native in appeal are the show grounds of the Argentine Rural Society, which for more than threescore years and ten has encouraged and rewarded improvements in cattle, sheep, pigs, and poultry.

The Palermo Livestock Show in the August chill is as much a society event as the Tigre Regatta, the San Isidro races, a José Iturbi concert, or a fashion show by mannequins from New York. The leading Argentine families are deeply rooted in the soil and a winning race horse carries no more social prestige than a prize Hereford, Aberdeen Angus, or Shorthorn bull.

In summer the showgrounds take on a side-show aspect, but in the big theater the outdoor revue surpasses its mid-city rivals.

Unless you are a cattle-breeder or one of his adoring satellites, it is easy to forego the fat stock parade for a streamlined ballet or a comedy in the Walt Disney manner.

Spanish songs are accented by clicking castanets; the resonant male voice of Hugo del Carril has a tonal background of guitars; criollo folk songs (*vidalitas, tristes, zambas*) are supported by the Kubik Chorus, a favorite with radio fans.

A prize bull would have to have bells on his ankles and a solid gold ring in his nose to compete with a show like that. Yet the Argentinos know that a side show is a side show, but a stock show, with animals selling at $10,000 each, the real hope of the Republic.

SUMMER OPERA AND SYMPHONIES

Even better ballets are staged in Palermo Park by the staff of the Colón Theater. Nor is the summer visitor deprived of symphonies and opera—if he gets there in time. Twelve cents a seat. First come, first row.

Seven thousand attractive, attentive people listen to *Carmen* or the *Barber of Seville* or watch *Les Sylphides* or the *Prince Igor* dances.

The orchestra, singing, and dancing are excellent, the air delightful, and behind the bright scenery and softly lighted tree tops arch the starry heavens, with Orion's belt—the gaucho's *boleadoras*—on the left and the Southern Cross on the right.

It would be rather hard *not* to enjoy such a midsummer night's dream in the January June of Buenos Aires.

YOUR SOCIETY'S RECENT MAPS

Members of the National Geographic Society are reminded that three recent maps received with their copies of the NATIONAL GEOGRAPHIC MAGAZINE and the indices to these maps afford a comprehensive chart and gazetteer of all theaters of the war on land and sea. These maps are Europe and the Mediterranean, April, 1938; Atlantic Ocean (no index), July, 1939, and Central Europe and the Mediterranean, October, 1939. Members wishing additional copies of the maps and indices may obtain them by writing the National Geographic Society, Washington, D. C. Price of each map, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen; Index, to Europe and to Central Europe, 25¢ each. Outside the United States and Possessions, 75¢ on paper; $1 on linen; Index, 50¢. Postage prepaid. A complete list of The Society's ten-color wall maps, including The World, Asia, Africa, Pacific Ocean, and South America, will be sent upon request.

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DANCING GIRLS REST NEAR AN ARCADE OF LIVING PLANTS IN PALERMO PARK

They have slipped away from the floor of an Avenida de Mayo restaurant to relax in this huge preserve of more than 90,000 acres, only twenty minutes from the heart of Buenos Aires (Plate XIII). Palm groves, rose bowers, and miniature lakes dot the vast stretch, officially known as Third of February Park to mark the day of the defeat, in 1852, of the tyrant Rosas (Plate VIII).

© National Geographic Society

Kodachrome by Luis Marden

TALLEST SKYSCRAPER ON THE SOUTH AMERICAN CONTINENT IS THE KAVANAGH BUILDING

Until its 28 stories pierced the Buenos Aires skyline (Plate III), the altitude record was held by the Palacio Salvo, across the river in Montevideo. In the Plaza San Martín (foreground) stands a monument to General José de San Martín (Plates VII and VIII).

© National Geographic Society

NARROW GAUCHO STIRRUPS ADMIT TOES ONLY

In place of a lasso, he carries the *boleadoras*, a rope with three lead balls at the end. When it is hurled at a steer, the balls whirl out, wrap around the leg of the animal, and throw it.

Kodachromes by Luis Marden

A SILVER COAT OF ARMS DECORATES HER TEA GOURD

The tube, also of silver, comes apart in the middle for convenience in packing. Visitors to Buenos Aires usually bring a maté container home with them as a typical South American souvenir.

BIRDS OF DIFFERENT FEATHER SWIM TOGETHER IN A BUENOS AIRES ZOO POND

Black-necked swan, at left; rosy-billed ducks between the humbler white varieties at right, and the coot in the foreground are residents of Argentina and adjacent lands. The mute swan, right rear, is a European bird, and the paradise duck, left foreground, comes from New Zealand.

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CAPYBARAS, EXPERT SWIMMERS AND DIVERS, IGNORE GOSSIPY PELICANS

These largest rodents, living in harmony with feathered friends at the Buenos Aires zoo, have partially webbed feet. Water plants and bark are their favorite foods.

IN THE ENTRANCE TO PALERMO PARK STANDS A MASSIVE SPANISH MEMORIAL

The monument was presented to Argentina by Spanish residents of the Republic to commemorate the first centenary of the Revolution of May, 1810. Not far from here, beside a lake, a statue of George Washington has been erected by United States citizens living in Buenos Aires.

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AT A SHARP CORNER THE MIRROR SHOWS MOTORISTS A WAGON IS COMING

Similar aids to driving have been erected on some of the large boulevards. The beret-topped citizen posts a letter in a British-type mailbox, near which stands a French bakery wagon.

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Kodachrome by Luis Marden

ARGENTINA'S LAWMAKERS LOOK OUT UPON A TREE-FLANKED PLAZA FROM THEIR CHAMBERS IN CONGRESS HALL

A copy of the statue of Rodin's "Thinker" stands in the foreground. Beneath the rows of spreading branches in Plaza del Congreso, shady park benches are favorite resting places for children and old folks all day long (Plate I).

© National Geographic Society Kodachrome by Luis Marden

PAMPAS ARTISTRY ADORNS A BASQUE MILKMAN'S HORSE

Bridle decorations are from designs handed down by the plainsmen of an earlier generation. Beret-topped immigrants from the Pyrenees form a large segment of Buenos Aires' population. Many Argentinians are of Spanish or Italian descent.

Kodachrome by Maynard Owen Williams

GAUCHO TRADITION SURVIVES ON THE STAGE

The girl is a member of a singing and dancing troupe in Buenos Aires. These performers bring to mind old-time carefree cattle punchers, just as cowboy and Indian shows in New York revive memories of North America's Wild West.

Kodachrome by Luis Marden

SMALL FILLING STATIONS FIT INTO A GENERAL PARK AND BOULEVARD PLAN

YPF is the Government-owned-and-operated oil company. When the attendant is not busy, he sits beneath his sunshade and reads a book.

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Kodachrome by Maynard Owen Williams

FRUIT FROM THE WHOLE PARANÁ DELTA COMES TO TIGRE BY BOAT

This wholesale market, on the banks of the Tigre River, handles an annual crop worth more than $1,000,000. Sportsmen also come here for boating, swimming, shooting, and fishing.

CHEMISTS MAKE A NEW WORLD

Creating Hitherto Unknown Raw Materials, Science Now Disrupts Old Trade Routes and Revamps the World Map of Industry

By Frederick Simpich

AT A NEW YORK fashion show, we saw a girl clad from head to foot in artificial materials. Everything she wore was made from synthetic stuffs created by chemists.

Her hat was Cellophane; her frock was rayon. She wore "Nylon" stockings and carried a patent-leather handbag and stood in imitation alligator shoes and wore "jade" bracelets and "ivory" beads; her parasol handle was from beautifully colored plastic.

Even the faint hint of musk on her imitation silk handkerchief came from a synthetic perfume; on her nails there glistened a synthetic dye, and other coal-tar dyes imparted rich shades to her ensemble.

No wool or linen, no silk or cotton, no ivory or jade, not even any leather, figured in her costume. Only the girl herself was natural—natural flesh and bone wrapped in her own waterproof skin (Plate I).

There she stood, a startling symbol of this new artificial world risen so fast since the World War. In newspapers, every few days, you read of yet another "miracle" from this or that great chemical laboratory —"wool" from milk; alcohol, rubber, and false teeth from gas; licorice from old stumps—or a new way to poison grasshoppers.

NEW FIBERS, PLASTICS, DYES

That this burst of activity in the rise of new man-made fibers, plastics, dyes, etc., today brings startling, almost revolutionary changes into our industry is plain, even to laymen.

But what does it all mean? What needs, or forces, suddenly set all our laboratories at this miracle-making?

Clear answers lie in the recent words of Dr. C. M. A. Stine, vice president of E. I. du Pont de Nemours & Company.

At the end of the World War, Dr. Stine points out, "Sheep, plants, and worms supplied the fibers for our textiles. Bone, hides, tusks, horn, the saps and barks of trees, the excretions of insect and animal life, and countless other products as ancient as commerce filled motor trucks and freight cars and the holds of ships, just as they made up the burdens of caravans in the days of Marco Polo.

"We were building and designing better homes, but of the same materials—stone, brick, and wood—of which homes had been built for thousands of years. We were wearing the same clothing that our great-grandfathers wore, merely cut to a new style and woven by machine instead of by hand. We were eating the same foods, using the same perfumes, sleeping in the same types of beds that the Caesars and Pharaohs knew."

Then a wave of inventive genius swept over the chemical world, and "we began to see wood, metal, fiber, rubber, and all other natural products not as raw materials in themselves, but as compounds of raw materials that are ever present in superabundance in the air, the water, and the soil."

COAL, AIR, AND WATER AS RAW MATERIALS

Coal, for instance, to a chemist, is far more than fuel; it is an almost limitless source of carbon. Air and water, too, are "inexhaustible reservoirs of oxygen, hydrogen, and nitrogen." Hence now, in these three sources—coal, water, and air—the chemist finds "the primary building blocks employed in the natural creation of silk, rubber, wood, camphor—in short, most organic things and their by-products."

Explore these chemical miracles further —see how they now affect our industry and daily lives—and you run into astonishing facts and unexpected thoughts. Also, you come to understand why the fashion show girl's outfit, though wholly synthetic, was yet beautiful, practical, and inexpensive.

Many of man's raw materials, even when he has carried them long distances, are not always perfect, or adequate. Wool, flax, hemp, hides, lumber, silk, even cotton, each in its own way has often given man a headache. Each, in its natural state, may have certain limitations. Metals he must make

Photograph by Willard R. Culver

"I CAN MAKE RUBBER, OR SMOKE, OR COLORS—AND SOMETIMES JUST AN AWFUL SMELL!"

All over America thousands of budding boy and girl chemists experiment with their toy sets. From such fascinating play come the laboratory wizards of tomorrow, as science marches on in its conquest of Nature.

harder and rust-proof; wood he must protect with paint or creosote; even water must be purified.

The list is long; but these are reasons why you see chemists busy not only with new alloys, paints, disinfectants, and fertilizers, but with synthetic leather, building materials, rubbers, fibers, dyes, etc.

On the brighter side, man needs the chemist to give him precious things. His women, like the girl at the fashion show, want to wear amber, jade, ivory, crystal, even pearls and other beautiful stones. These man can't always afford; many are rare and dear. So now, by synthesis, chemists make them at low cost.

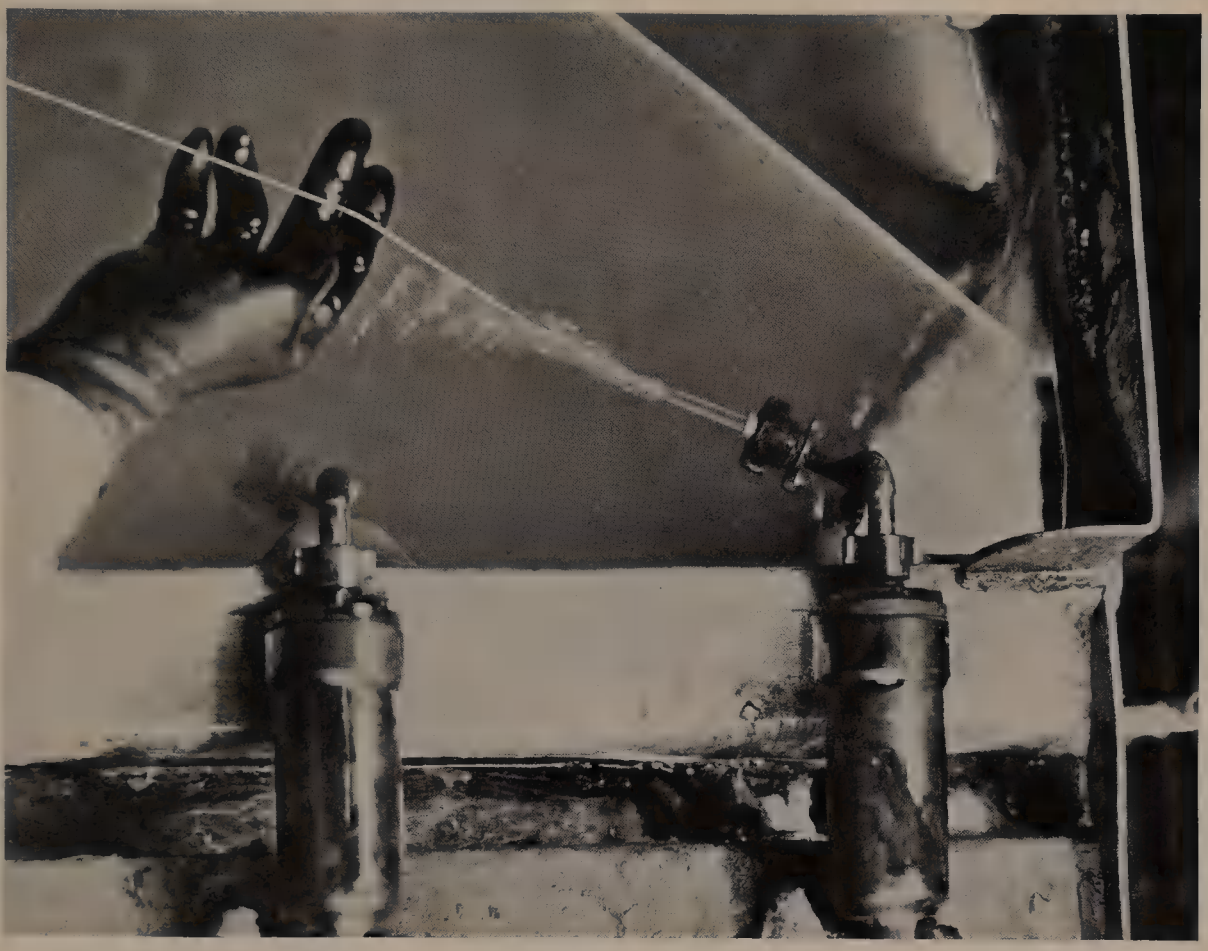
Rare perfumes are also dear to some women's hearts. With them they attract the male. On the style show girl's handkerchief, we said, was artificial musk. Real musk few could afford—or even find. It comes from a fleet, graceful male deer that frolics among the high crags of the Himalayas. One pound of natural musk—if you could find that much—would cost about $40,000 and you might smell it from New York to Chicago.

Today's synthetic musk costs only a few hundred dollars a pound—and you might smell a pound of it no further than from New York to Brooklyn. But it serves the perfumers and saves wear and tear on the Asiatic deer, just as artificial ivory has made loafers out of many old tusk hunters.

Some things chemists do now would have been classed in Bible times with the miracles. As when water was turned into wine, chemists make things today which even differ chemically from the raw stuffs whence they spring.

PERFUME FROM COAL TAR

To make alcohol from molasses, or dyes from plants, is mere chemical change easily understood. But the magic of soft panties from lumps of coal, or sugar from pine



VISCOSE LIQUID SQUIRTS INTO A CHEMICAL BATH AND TURNS TO RAYON THREAD

Lay this picture flat. Then you look straight down into a tank over which a gloved hand reaches to fish up newly formed fiber. Through tiny gold-platinum spinnerets in the nozzle (right), copied after the business end of the silkworm, syrupy cellulose ejects, to coagulate in the chemical bath (page 623).

trees, or delicate heliotrope scent taken from stinking coal tar, seems akin to the wizardry of ancient alchemy and its myths of base metals turned to gold.

Today in du Pont's laboratory you actually see fine, silky thread for underwear and hose made from coal, air, and water. "Nylon," they call this new fiber which is a challenge to natural silk and even to rayon. When hardened and formed, it also makes bristles, going now into millions of toothbrushes. What Roman holidays this means for wild pigs in Siberia! Now, for all the chemist cares, pigs can keep their bristles (Plates XI, XIII).

Nitrates from the air; fruit flavors from tar; bromine from sea water; glossy fabrics from spun glass; all these hurdles our chemists take in their stride.

Volcanic in their furious heat and pressure are also man's present-day machines, needed to make such things as Nylon and artificial rubber. Before electricity led him into the Power Age—and to new alloys that support terrific heat and pressures up to 25,000 pounds an inch—he could not have made all the things the girl wore at the fashion show. So engineers in other fields aid in the march of synthetic chemistry.

To study the groups of molecules, du Pont chemists use a supercentrifugal machine that whirls at 60,000 revolutions a minute. It takes 1½ hours of steady running to work this whizzing little bowl up to top speed—and then another 1½ hours to stop it! At full speed a speck on its rim travels at a rate which would mean speed of 1,200 miles an hour. If made of ordinary metals, the bowl would fly to pieces from centrifugal force and perhaps shoot bystanders to death.

THE GEOGRAPHY OF CHEMISTRY

Only new, incredibly tough alloys make possible this machine and other large ones now in factory use.

Photograph from Wide World

DAUGHTERS OF ITALY VISIT THE NEW YORK WORLD'S FAIR GARBED IN GARMENTS OF TOMORROW

Skim milk, bamboo, and grass are among raw materials used in their costumes. "Lanital," a new textile half wool and half casein, is now enormously produced in Italy, going not only into women's garb but into army uniforms and overcoats (page 622).

"Yes," you repeat, "we know all that. But *why* do men make all these imitations? Take the case of your mannequin at that style show. Is her novel garb more than a chemist's trick, just to show what he can do?"

Indeed it is. Synthetic items in her costume are made now for sound reasons that range from economic to political, and even geographic.

Foreign trade routes, merchant ships, barriers, embargoes, tariffs; occasional scarcity or lack of uniformity in raw materials; jobs, wages, prices, even the germs of war itself, all figure in the reasons why man is creating this new world of artificial things.

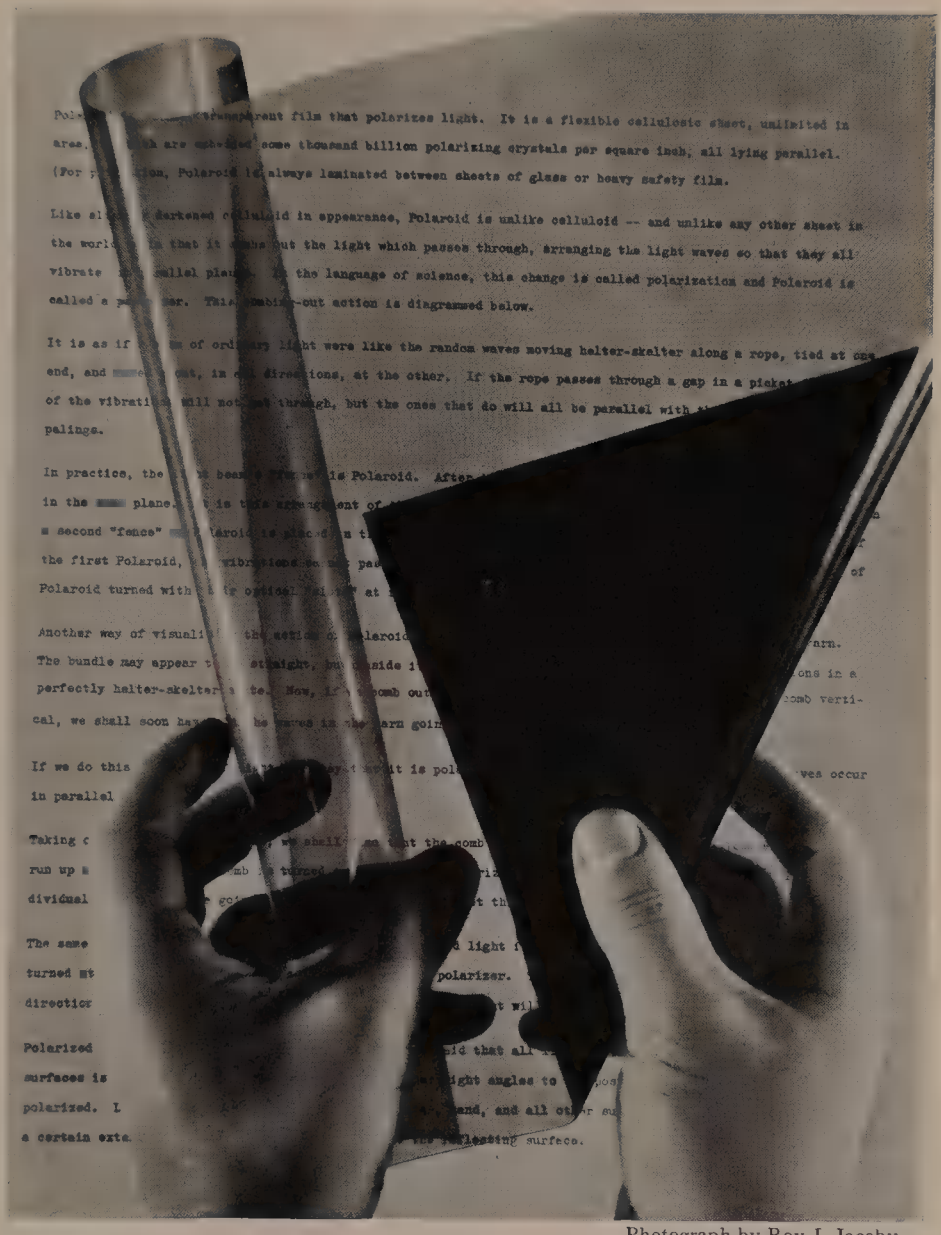
Consider first chemical geography. In the United States chemists may find all they need of such common yet useful materials as salt, sulphur, limestone, coal, phosphates, potash, bauxite, oil, natural gas, rosin, etc. Nickel and arsenic, however, we must buy abroad; we also lack tin, antimony, manganese, and chromium.

Benevolent as Mother Nature is, if we still depended wholly on her, we should also have to import all our rubber, nitrates, camphor, many vegetable dyes, perfumes, certain flavors, drugs, and other things.

So today, synthetic chemistry aids us to be more independent; not completely self-contained, in the sense of one big, happy Swiss Family Robinson, but far more so than just a few short years ago.

As one easy, yet dramatic reason why we make synthetics, look at nitrate, which chemists now pull from the air as magicians pull rabbits from a hat.

When our fashion show girl's mother planted flowers—or was it cabbage?—the



Photograph by Roy J. Jacoby

YOU SEE THROUGH IT WHEN ROLLED; WHEN FOLDED, YOU DON'T!

Billions of iodine and quinine crystals on the cellulose sheet form optical slots in which rays of light are flattened into parallel ribbons as they pass through. Twirl the slots out of line and you block the "light ribbons." One can look through several thicknesses of a Polaroid sheet, as they are in the roll at the left. Where the corner of the sheet is turned up, the slots are crossed, so no light may pass through. Polaroid light control is used now in antiglare glasses and lamps, and in three-dimensional movies. Some day, when Polaroid is adopted for automobile lamps and windshields, headlight glare will be eliminated and driving at night made safer (page 629).

Photograph by Drucker-Hilbert

BETTER THAN X-RAYS, THIS CAR'S TRANSPARENT BODY REVEALS ALL ITS INNER WORKINGS

With hood, fenders, and body panels of glasslike plastic, this Pontiac is shown at the New York World's Fair. Murals in the background are by Dean Cornwell and trace the steps in the making of a motorcar body.

Photograph by Willard R. Culver

WHAT A LONG STEP FROM PREHISTORIC POTTERY TO MOLDED PLASTIC PLATES!

He merely inserts the resinous molding material, works his hot, heavy press, and out comes a strong, light, graceful piece of tableware. Billions of plastic articles, from toys to battleship gadgets, are thus molded or pressed each year.

fertilizer she used was part nitrate, an essential plant food. You can't make gunpowder, either, without nitrates. For years we got this from Chile's nitrate fields, when Chile had a world monopoly.

MINING NITRATES FROM THE AIR

Then ships from all nations cut sea paths to Chilean ports, and great economists like Sir William Crookes dismally predicted that in time we might starve, should science find no substitute before Chile's niter beds went empty. Well, science found it. The how and where is a long story; it stretches from Scandinavia to Germany and down to Muscle Shoals and later out to Belle, West Virginia.

When the du Ponts went into West Virginia and put up tall chimneys and big shiny tanks and explained to the farmers that they were about to pull fertilizer out of the air, dubious agrarians nodded and "allowed somebody was crazy." But there the du Ponts are actually doing that now, just as a hundred air-nitrate plants are doing it now at a hundred other places.

So today the big fleet of nitrate ships no longer hurries to Chile. Exports from the desert nitrate fields have shrunk; fewer men find work there; but at the new air-nitrate plants thousands of new jobs have been created. That's what we mean when we say chemists are changing the setup of ocean shipping and international trade.

"HOLD STILL A MINUTE—THIS WON'T HURT A BIT!"

Dentists and surgeons may now use cold beams flashed through "Lucite" plastic rods to explore oral and other cavities in patients' bodies. Remarkable, too, is this plastic's power to carry light around a bend, as in the curved rod shown here (page 619).

That West Virginia nitrate plant is also a perfect example of the chemists' proverb that "one thing leads to another." In working out ways to purify gases and make nitrates and ammonia, they hit on how to make methanol, other alcohols, and urea. This meant more new jobs in West Virginia, but it laid off hundreds of old workers elsewhere who used to make "wood alcohol" from wood.

Similar trade repercussions are due from the advent of Nylon. Silk is Japan's chief

export to us; but Nylon is more elastic than silk, and man can control its volume and hence its price. When it cuts into silk sales, the same trade upset follows as in the case of nitrates, pig bristles, camphor, etc.

Without camphor, the fashion show girl could not have had her plastic ornaments; without camphor, there could be no celluloid, nor many other chemical products. So here again when one nation, because of its strategic map spot, was able to limit our supply of camphor, or deny it altogether, our chemists began to make it by synthesis. This drama of camphor shows again how our chemists can disrupt old currents in trade geography.

STUMPS 50 YEARS OLD YIELD CHEMICAL TREASURES

Green trees on far Taiwan (Formosa) scent the island air with familiar drugstore fragrance. That's camphor, so named by Chinese.

From camphor wood sap, crudely treated, the Formosans formed cakes, traded through the East long ago as pagan amulets. In time, by caravan and junk, India, Egypt, and the Arabs came to know camphor; the latter, always experimenting, made medicine from it and passed it on to the Turks. So it came to Europe. Today industry consumes carloads of it. After Japan took Formosa from China, in 1895, she built up a world camphor monopoly. From this our chemists freed us by making camphor from turpentine.

Turpentine itself to the fashion show girl's old grandpa was just turpentine, made from the sticky exudate of pine trees. Today you see chemists taking 100 or more new things from rosin and turpentine, including oil for disinfectants, insecticides, perfumes, and flavors.

Licorice, made from stumps, is another synthetic that tends to upset old jobs and old trade connections and form new ones. Over in Iraq and Syria, Arabs dig wild licorice root. Baled and shipped, it lands here for use in our candy, baby medicine, chewing tobacco—even in certain fire extinguishers. Now all these Arab workers in the far Levant must compete with Georgia workers, who can make a synthetic that smells, tastes, and acts like real licorice.

To our symbolic girl's country kin, also, old stumps merely cluttered the corn or cotton fields; to get rid of them took hard, costly work. Now the turpentine makers not only dig them up free, but pay for them.

MAN MAKES BRIGHTER, FASTER DYES THAN NATURE'S OWN

The only natural color on that girl at the fashion show may have been that in her blue eyes. For of pink cheeks, red, black, or blond hair, fingernails, and even summer "tan," Nature is no longer the sole boss.

Of course Nature still controls the colors of birds, flowers, green grass, blue skies. This would be indeed a monotonous world if all of one color—or no color at all! Even insects and beasts find food, flirt at mating time, and outwit enemies by use of color.

A mere pinch of history shows that Egypt made dyes from the indigo plant centuries ago. Later pelagic man, about the Mediterranean, used a shellfish to make the "royal purple" of Greek and Roman times, a costly color reserved for royalty.

Federico, a Florentine, found in the 15th century how to make dyes from lichens. From Mexico, in 1518, Spaniards brought the cochineal bug, used by Aztecs in making color. Dyewoods came into use and one of London's oldest guilds is that of the dyers.

Not till the 19th century did chemists ponder the use of coal tars. Finally William Henry Perkin, seeking to make synthetic quinine, found a coal-tar dye he named "mauve."

Till after the World War, we depended on Germany; everybody remembers how the submarine *Deutschland* sneaked into Baltimore with dyes that sold for dizzy prices. We had then so few dyes, and such poor ones, that our coat collars turned our necks blue and green, and Uncle Sam couldn't even properly color his postage stamps.

Now we can make all the dyes we need and export some. Du Ponts spent $40,000,000 on experiments and factories before they earned a cent on their dyes. Their huge plant at Deepwater, New Jersey, is a city in itself (Plate XV).

Hot blasts rise from dryers. Giant cylinders rumble, vats bubble; acids—and ice, too—get in their work, and stinking rivers of every hue flow mysteriously about in fat pipes that twist and turn like sea serpents.

But don't try to understand it all. Not

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Kodachrome by Willard R. Culver

A LIVING SYMBOL OF THE CHEMICAL AGE

She wears no silk, wool, linen, cotton, or leather—no jade, ivory, or pearls. All is synthetic. From cellophane hat, rayon dress and gloves to plastic pearls and bracelet, patent-leather shoes with plastic heels, and a handbag with a "Lucite" plastic frame, her outfit is all of laboratory origin.

BIOLOGICAL SPECIMENS PRESERVED IN TRANSPARENT RESIN

This glossy-looking plastic is from the Philadelphia laboratory of Rohm and Haas. Objects are mounted in it for research and exhibition purposes by the U. S. Department of Agriculture.

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Kodachromes by Willard R. Culver

SCIENCE EVOLVED NEW MATERIALS TO MAKE ALL THESE USEFUL THINGS

Birds in the turban are of "Plastacele"—a cellulose acetate plastic. "Lucite" forms the walking stick; the perfume bottle is of synthetic amber. From other man-made materials came the vanity case, gloves, scarf, mannequin's head, model hand, etc.

AMBER, IVORY, OR JADE—RARE AND COSTLY—ARE NOW REPRODUCED BY SYNTHESIS

Chemists abhor the words "imitation" or "substitute"; they say, "We've made a wholly new material, as beautiful as Nature's product, but cheaper and often better."

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LUXURIANT BRILLIANCE EMANATES FROM GLITTERING PRODUCTS OF CHEMICAL ART

Her robin's-egg blue negligee and her slip, as well as lamp shades and table "skirt," look like silk, but they're rayon. That toilet set of tea-rose tint is of "Pyralin" plastic, not onyx, and "Lucite" forms the brush and nail-file handles.

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Kodachrome by Willard R. Culver

HERE NATURE SUPPLIED ONLY THE GIRLS, THE PLANT LIFE, SEA, AND SAND

In this scene everything else is of artificial, man-made materials. Bathing suits, the beach dress, hat, umbrella, plates, napkins, tablecloth, sun glasses—even the book covers of "PX cloth"—are made of synthetics.

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"WRAPPED IN CELLOPHANE," FOOD KEEPS FRESH AND CLEAN

In this factory scene pieces of hard candy pour from an automatic wrapping machine at the rate of 160 a minute. The girl inspects each piece before boxing for shipment.

Kodachromes by Willard R. Culver

GLASS YOU CAN WEAVE LIKE SILK

Using standard textile machinery, strands of glass are combined to form yarns and threads which can be fabricated into cords, braided sleevings, cloths, and decorative fabrics (Plate XIV).

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Kodachrome by Willard R. Culver

QUEEN OF LOLLIPOPS, IN GLOVES, BOXES PEPPERMINT BALLS

Choosing and blending colors, flavors, and aromas in candymaking is another chemist's job. In Henry Heide's New York factory hard candy is striped red with food colors certified as pure by the United States Government. Our grandparents boiled molasses on the kitchen stove at their candy-pulling parties; now scientific candymaking uses sugar by the carload, tons of imported almonds, coconuts, and other tasty ingredients.

WHAT A BUSINESS BOOM PLASTICS BRING TO SANTA CLAUS!

Popeye, Susie Damm, Mickey Mouse—or just rattles and teething rings—they're all here. Besides their wide use in toys, celluloid and "Lumarith" have some 25,000 other applications in industry.

© National Geographic Society Kodachromes by Willard R. Culver

A SYNTHETIC CHEMIST'S DREAM CAME TRUE!

The baby radio looks exactly like onyx, but actually it's "Catalin." To factories that transform it into dice, chessmen, toys, toilet sets, and jewelry, this raw plastic goes in the form of rods, bars, and tubes.

© National Geographic Society

Kodachrome by Willard R. Culver

TRULY NOW SCIENCE WITH LUSTROUS MAGIC GILDS THE LILY

Thanks to mass production of man-made textiles, women today can be better dressed than ever before, and at less cost. This garment in tango shade is of rayon, which now so largely displaces silk.

even the dictionary will help; only a chemist, who knows the symbols and equations, can follow this color cookery!

"How many dyes do you make?" I said.

"Oh, about 100 new ones every year, for as many new uses. In our color charts we show about 1,700 different shades."

"How many can you see, walking through fields of wild flowers in springtime?"

"Not so many as we make, by far. I can shut my eyes and imagine about 100,000; in fact, any trained dye chemist's eye can recognize fully 100,000 hues and colors. In a batch of yellows, for example, he can detect the presence of red, if it's only 1/20,000 of the batch. That's how in our standardizing laboratory we can pass confidently on every ounce of dye we make. Each lot is tested and compared with the particular standard set for it" (Plate IX).

FACTORIES USE COLOR CHARTS

Whether a customer wants to dye gloves, furs, silk, rayon, cotton, leather, or wallpaper, he can come here, choose just the shade he wants from a color chart, and they'll reproduce that exact shade for him.

Here they even have miniature tanneries and paper mills, in which they make their own samples for use in tests.

Here too they grind pigments for paints and printing inks.

"Not so long ago," they tell you, "printers had to hang magazine pages up to dry, like family wash. Now chemists can make ink that dries so quickly that you can handle a sheet, printed in colors, as soon as it's off the press."

Most printing inks are composed primarily of varnish in which color is suspended. Unlike dyes, the colors used in printing inks are powderlike pigments which do not actually dissolve. In the old days pigment colors came from natural sources, such as earths, and plant and animal extracts. Those colors were few in number, often dull, and quick to fade. Chemistry has given us the numerous brilliant colors of today, creating them from such surprising materials as pig lead, coal tar, and iron ore.

Here again dye chemists disrupted an old trade. Hordes of workers in India and elsewhere, who grew the indigo and madder plants, lost their jobs when man produced synthetic dyes, and millions of acres of land had to be idle while farmers planned other crops.

Other examples exist. Ivory hunters in Africa passed from romance with the rise of synthetics. We've seen what happened to Formosa camphor tree owners, to Chile's nitrate monopoly, and the slant-eyed boys who thought bristles could come only from Siberian swine (pages 603, 607, 608).

Now looms the giant of all examples, rubber. We still depend on Nature for it. But, should war shut us off from overseas rubber supplies, we could, in some months' time, be making enough synthetic product to meet our needs.

"Nature made rubber latex, then threw away the formula," said discouraged chemists after years of laboratory toil. But now they have it. Today's synthetic rubber, better in some ways than the natural product, comes not from plant life, but minerals.

That mannequin's shoe heels, you may have noticed, were not leather or wood. They were shiny, scuffless plastic, pressed from some glassy mystery, hard and durable, yet light as cork.

MAN-MADE PLASTICS ADD TO WOMAN'S CHARM

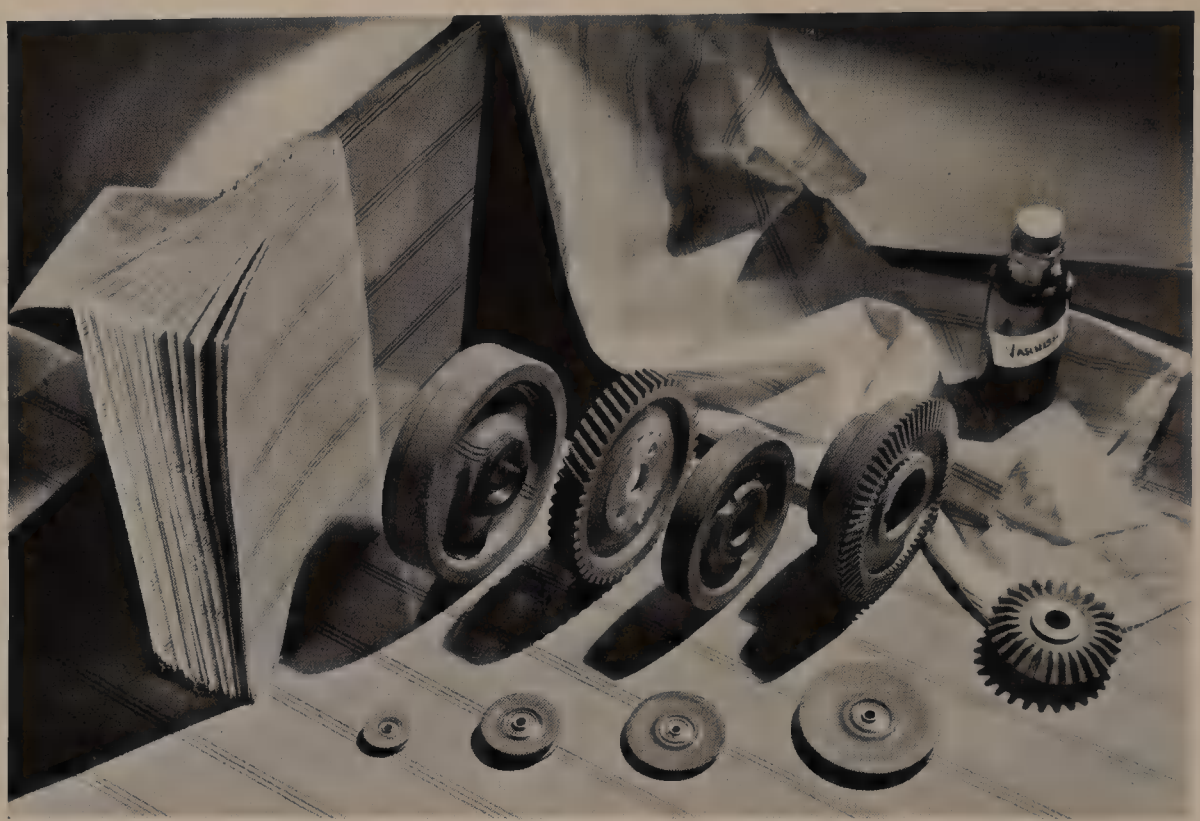
On her dressing table, had you seen it, as now on thousands of others, all the fancy combs, brushes, mirrors, trays, vanity cases, and cigarette holders were also of plastics (Plates III and VII).

All over America now such natural things as wood, bone, amber, ivory, tortoise shell, as well as porcelains and some metals, have been so supplanted by synthetics that you can hardly turn in your own home without touching one. Their trade names are as Greek; but all about us are "Bakelite" telephones, "Catalin" dice and bracelets, "celluloid" toys, "Lumarith" tool handles, "Beetleware" goblets, things of "Plaskon," "Glyptal," "Vinylite," "Tenite," and other "chemical compositions."

Pioneer was celluloid. Back in 1868, John W. Hyatt, an Albany printer, set out to make an imitation ivory billiard ball. He did it, by blending camphor and nitrated cellulose, and so produced the world's first thermoplastic.

In 1890, when the Celluloid Corporation found a way to make transparent celluloid sheets in continuous lengths, it laid the base for the motion picture business. Today celluloid and its offspring find some 25,000 industrial applications.

Most plastics are resinous compounds. Natural resins come from plants and trees,



THINK OF GEAR WHEELS CUT FROM PRESSED CLOTH!

This type of "Formica" plastic is made by impregnating stacked-up sheets of cloth with a varnish mixture, then applying heat and pressure. Many gears made of plastics require no oil, being self-lubricating.

Photographs by Willard R. Culver

CUTTING MIRROR BACKS FROM A SOFTENED, ONYXLIKE PLASTIC SHEET

Woman's desire for beautiful materials at low price led science to evolve such new things as this synthetic onyx. Plastic raw materials come in various forms, from molding powders to rods, bars, tubes, and sheets, ready for cutting.

FABRICS, TREATED WITH FLAMEPROOF AGENTS, RESIST FIRE

Burning brightly is an untreated cloth; at right is a chemically protected sample that scorched but did not blaze when a lighted match was held to it. On a "treated" cushion, at left, gasoline was poured and fired, but only the gasoline burned.

and include shellac and pitch; Bakelite, used for years to make insulating parts, like later synthetic plastics, is a child of the laboratory.

Straight celluloid is highly inflammable; and hot sun will warp a talking-machine record made of shellac. But in 1907 a thermo-setting resin which would undergo a chemical change in hardening, and stay hard despite any heat, was found. Dr. L. H. Baekeland discovered it when he heated a mixture of formaldehyde and phenol, or "carbolic acid." He named his product "Bakelite" and as such some 50,000,000 pounds a year of it are now used.

Laminated plastics, made by many sheets of plastic-impregnated cloth, paper, or plywood pressed together hot, possess amazing strength. Bakelite is used in this way to make airplane fuselages. Such plastics also go into gear wheels, wallboard, instrument panels, and other things; they supplement and often wholly replace wood, steel, and slate. On the *Queen Mary* de luxe staterooms are lined with fireproof plastic wallboard, and at Washington the Library of Congress used Bakelite in laminated plastics.

LIGHT FLOWS THROUGH A PIPE

"Lucite," a new addition to the plastic family, is transparent as glass. Through a rod of Lucite, light flows as water through a pipe. To show me its magic, a du Pont chemist held up a bent, twisted rod of this "glass." To one end he held a lighted match; I looked along the rod and saw no flicker of light. Then the chemist said, "Look at the other end!" And there was the light, coming out!

In surgery and dentistry, Lucite instruments are used to illuminate body and oral cavities without risk of burning the patient, because the light bounding through the rod is cold! (Page 607.)

Lucite reflectors, set along highways, prove many times as bright as glass.

Chemists again dislocated a lot of work-

Photograph by Farley Utes

"THIS STUNT BORES ME—MY DOUBLE CHIN AND WRINKLES ALL SHOW!"

Here a pouting pachyderm tests one of Pacific Forest Industries' plywood planks. But four elephantine tons can't break a 29-ply, chemically waterproofed board barely two inches thick.

ers and upset some long-established trades when they produced plastics. Today pounding presses and speedy molding machines disgorge by millions many objects that used to be made by hand or on slower machines.

THE MYSTERY OF PLASTICS

You can't define a "plastic" by merely saying it's something that can be molded by heat and pressure.

At the National Bureau of Standards, in Washington, they show a whole room full of plastic products. They group them in four types. First is synthetic resins, which may go into any object from tableware and jewelry to steering wheels and radio cabinets. Then come door knobs, telephone parts, and talking-machine records made of natural resins, which we commonly know as rosin, shellac, pitch, and asphalt.

Cellulose derivatives in the plastic trade show up in safety glass, photographic film, artificial leather, lacquers, airplane "dopes" and celluloid toys, hairbrushes, pens, pencils—thousands of things you see in drug and novelty stores.

To see plastic objects being made, have a look at General Electric's factory at Pittsfield, Massachusetts. Here you see hundreds of workers cutting dies, while others, both men and girls, mold the various articles at the rate of nearly a million pieces a day on batteries of presses that run like stamp mills in a mining camp.

Photograph by Willard R. Culver

SCULPTORS FIND A NEW MATERIAL IN TRANSLUCENT PLASTIC OF PHENOLIC RESIN

Ralph Mancuso polishes his statue "Foreign Relations," seen now at the New York World's Fair with other figures by this sculptor, in the U. S. Government exhibit. Each plastic statue is 9½ feet high, and is lighted from within.

FROM WATCHING SILKWORMS DIGEST LEAVES, A FRENCH CHEMIST WAS INSPIRED TO MAKE CELLULOSE AND RAYON!

Here in a rayon works, a shredding machine has just ground up some cotton linters and spruce pulpwood to make alkali cellulose. This is one step in the manufacture of man-made textiles near Richmond, Virginia.

When a customer wants, say, 10,000 plastic heels for women's shoes, 50,000 steering wheels, or 10,000 cabinets for radios or teletype machines, he submits his model or pattern; then G. E. die cutters make the necessary steel mold. They can show you nearly 9,000 different molds, used in making as many different kinds of plastic articles.

BY SYNTHESIS, MAN NOW MAKES FABRIC

Change is swift and incessant; a $10,000 press built only two years ago may already be scrapped and replaced by a later model.

Eve was naked; Nature left her so. The fig leaf was man's idea. All his agelong labor to clothe himself, since he first wore wolf, rabbit, or leopard skins, has been to gain more comfort. Furs, wool, linen, cotton, silk—all have served him.

Today, for the first time in centuries, man has new fabrics for his clothes. Rayon is most widely used of synthetic textiles. Nylon and another new one, "Vinyon," are coming on.

Italy uses "Lanital," half wool and half milk, or casein. Short of wool in her Ethiopian campaign, she turned to this casein fiber and now uses millions of yards of it in suits, dresses, socks, overcoats, and blankets. Germany has long used synthetic textiles, even a processed paper, for clothing.

Two American chemists, E. O. Whittier and Stephen P. Gould, have just patented a still newer way of making yarn from milk. Of it Dr. Whittier says: "It is unsafe to predict the future of casein fiber in this country; but there appears to be a real need for an inexpensive fiber to be used as a diluent or extender of wool so that our inadequate supply of wool may be made to satisfy our needs at a lower cost.

"We have a potential annual supply of skim milk of 40 billion pounds over and above that now converted into manufac-

tured products. This is equivalent to one billion pounds of casein fiber. It is equal to world production of rayon and is twice the consumption of wool in the United States. The economics of the textile situation will determine how far we go with casein fiber."

Here again, should America go for artificial wool as it has for imitation silk, you can see what further trade disruptions would occur, say between Boston and Buenos Aires, or Australia—to say nought of our own western sheep States.

Photograph courtesy Owens-Illinois Glass Co.

WHO WOULDN'T WHISTLE AT GLASS SPUN LIKE SILK!

Alice in Wonderland never saw any feat more astonishing. Fancy taking an old windowpane or a broken milk bottle, spinning such fragments into lustrous fiber, and then weaving yourself a pair of bathroom curtains! (Page 629.)

FIVE TIMES AS MUCH RAYON USED AS SILK

Rayon was man's first long step in his quest for artificial textiles. Its dramatic history shows vividly how human patience and ingenuity again not only stole Nature's secret, the mechanics of the silkworm, but actually built a textile superior in many ways to the silk it imitates.

In voluminous writings on rayon, as synthetic silk is now named, the work of dozens of experimenters is traced. One great name, most commonly associated with rayon's development, is that of Count Hilaire de Chardonnet. He played with the syrupy solutions of cellulose and gained much by the discoveries of other European experimenters. As a student he had worked with Pasteur in Paris and knew of his efforts to cure a silkworm disease which at one time threatened to destroy the French silk industry.

Toiling in the twilight zone of atoms, he watched the silkworm exude its fluid through fine holes in its body.

From this came the idea for the "spinneret," that tiny platinum-gold disk full of fine holes used now in all the rayon mills. Through these spinnerets, man forces his chemically prepared cellulose; toughened in a chemical bath, picked up and wound on wheels, it forms into spider-webby filaments, 1,000 miles of which may weigh but a pound (page 603).

Now man can't control Nature's silk-

Photograph by J. Baylor Roberts

FROM ONCE USELESS PINE STUMPS MAN NOW EXTRACTS PRIZED CHEMICALS

Rosin, turpentine, synthetic camphor, synthetic licorice, insecticides, and many other useful things are recovered from old pine stumps; here wagonloads of such splintered old snags are being delivered to Hercules Powder Company's mill at Hattiesburg, Mississippi.

worm. But he is master of his own machine. So he can make rayon fiber finer than silk, or coarser than horsehair. He can give it any luster, too, from gray, chalky dullness to the silvery brightness of shiny metal (Plate VIII).

Rayon, of course, dealt a staggering blow to the silk industry; Japan recouped by building rayon mills and becoming the world's largest producer of rayon.

In America we get cellulose from wood and cotton linters.

Treated with nitric and sulphuric acids, cellulose forms pyroxylin, which is the base of motion picture film, quick-drying lacquers, gunpowder, and various plastics. At the Eastman Kodak plant in Rochester, you see them dissolving truckloads of silver bars, making salts of silver with which to coat their cellulose (Plate XII).

If acetic acid is used, the yield is another compound of cellulose; it then goes into acetate rayon, and many things from fountain pens and airplane windows to lampshades and safety X-ray film.

THINGS BORN IN A LABORATORY

Look at the showcases in any drugstore, or check over items in your own home, and you'll be amazed at how many were born in a laboratory! Combs, brushes, buttons, buckles, bracelets, pens, pencils, fingernail tint, costume jewelry, fishing tackle, candy and hatboxes, cigar, cigarette, and food wrappings—even your wife's hat, hose, underwear and gowns, as well as your window shades and draperies.

Kin to rayon is cellophane, another white rabbit from the chemist's hat. It, too, is made through a spinneret, but comes out

AGAINST THE RAVAGES OF HUNGRY INSECTS MAN FIGHTS TO SAVE HIS FOOD

On this revolving table the chemist sets his food plants, on which captive pests have been released. Then, by trial and error, he finds the most effective poison (pages 626, 627, 628).

through a slit instead of fine holes, which makes it flat.

Hollywood used 50,000 yards of "cellophane to make moonbeams" when they shot "A Midsummer Night's Dream." The stage makes glittering transparent costumes from it. Besides its wide use as a wrapper, radio has used its "rustle" in sound effects.

MOVIE FILM TO PATENT LEATHER

Cellulose in yet another form went into the patent-leather shoes on that girl at the fashion show, and into the handbag she carried. You can't see it, but hidden in her bag or lost in her shoes is part of the 250,000 miles of film love, romance, and adventure pictured last year in Hollywood.

"That sounds crazy," you say. It does; but it's absolutely true. Much of our patent leather is made from discarded motion picture films, and other film scrap, and so patent leather, like the "house that Jack built," may start with cotton fields and silver mines, turn into photographic film, run through studios, be released to theaters all over the land, end as junk, and be reclaimed to make coatings for artificial leathers. Of leather, and its imitations, we use so much that Nature can't supply it all. If all we used was made in the old way, from cowhides, we should have to graze practically the whole Mississippi Valley to raise cattle enough to meet our need for hides.

EVE NEVER SAW A BEAUTY PARLOR

From fig leaves and leopard skins to rayon and patent leather made from canned romance! Truly a long step; yet only one more in man's creation of his artificial world.

Photograph by J. Baylor Roberts

BELCHING POISON AGAINST TOBACCO WORMS AT ONE ACRE A MINUTE

The plane flies low and operates only in early morning, when the air is still and the crops wet with dew. Poison itself is carried in dust made of lime, talc, or bentonite clay (page 628).

Photograph by Akron Studios

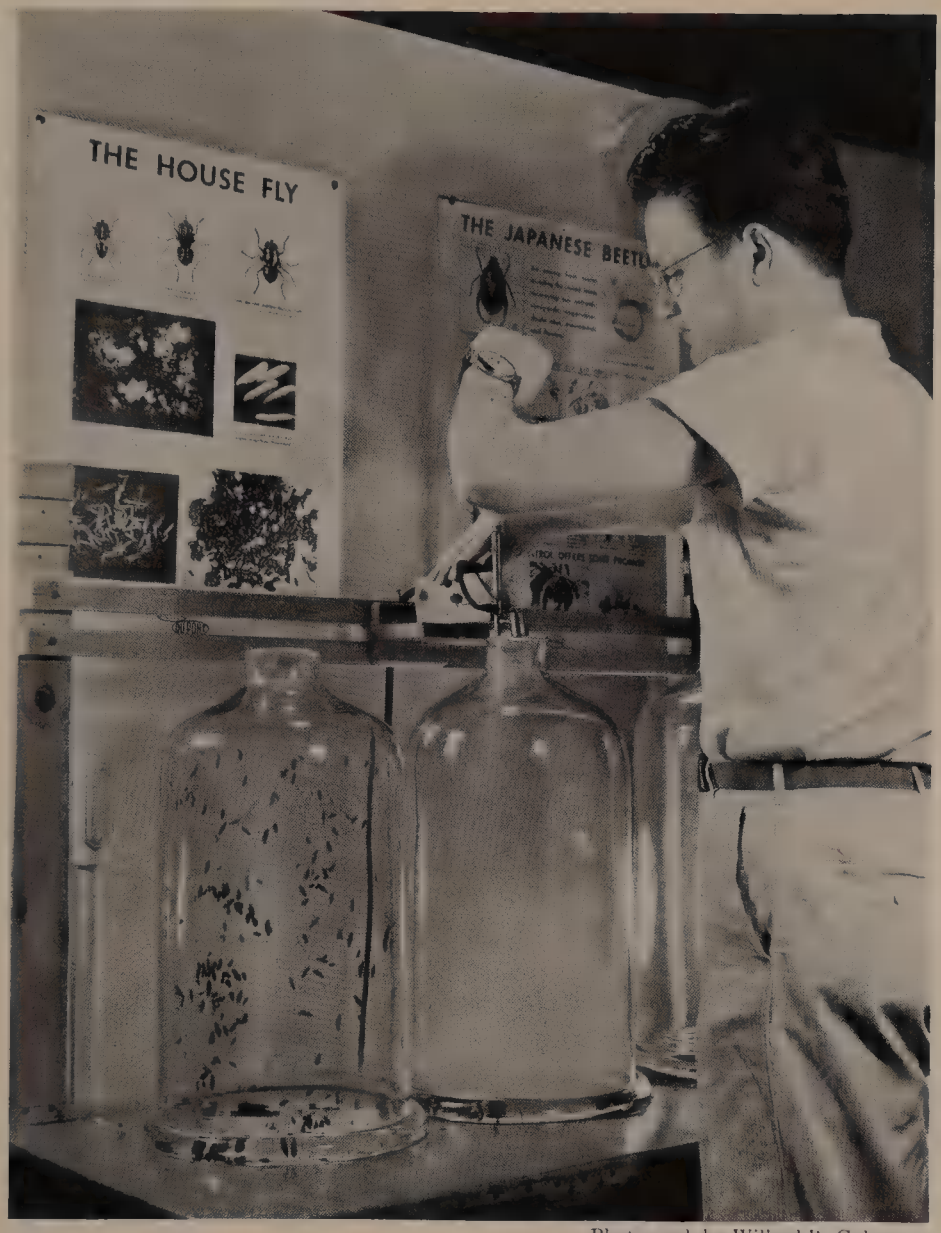
GLOVED AND GOGGLED, AMID HEAT AND STENCH HE TESTS HIS ACID

These jumbo vats are sulphuric-acid coolers in the chamber acid plant of the du Pont Company's Grasselli Chemicals Department, at Philadelphia. By odd coincidence, the first United States patent ever granted went to a Philadelphian for a sulphuric-acid process (page 632).

Washing her hair in one of the "Three Rivers of Eden," Eve dried it in the hot winds of what became Babylonia, and is now Iraq. Centuries later her pioneering daughters built crude ash hoppers, made lye, and boiled it with animal fats to make soap. In a few backwoods districts they still do it (page 631).

But great factories go far afield for raw materials; in fact, the geography of modern soap making spreads around the world. From far lands come now the cargoes of strange oils to be chemically analyzed at the factories and used instead of homemade lye and lard.

Filipino coconuts, Nigerian palms, Mediterranean olives, Chinese peanuts, sesame, tallow trees, and soybeans, even Russian sunflower seeds, ride the seas to make our soap.



Photograph by Willard R. Culver

WE MIGHT STARVE BUT FOR CHEMISTS' RELENTLESS WAR ON INSECTS

Flies are a pest that science seeks to control. Beetles, moths, mosquitoes, roaches, army worms, potato bugs—all menace man's health or food supply. Incessantly chemists work to thwart the villainy of such hungry hordes (pages 625, 626, 628).

Fable says man's first soap came by accident when he dropped some tallow from altar candles into a pile of wood ashes on Sapo Hill, outside ancient Rome; hence the name "soap." A crude soap was made in France in the second century, and Castile soap was named for early factories in Spain. In 1800 a French chemist found that soda could be made from common salt; this cut the cost of soap and it came into general use.

Chemists, however, remain the masters of ceremonies in every big factory. Outside Cincinnati, in Ivorydale, you see the colossal plant of Procter and Gamble. Long trains of their tank cars arrive every day with world-wide collections of oils and fats. Here rise 100 gigantic kettles, tall as 3-story houses; each holds 5 carloads of fats. Over each boiling kettle stands a master soapmaker. Now and then he drops down a small bottle on a chain and hauls up a sample for chemical analysis. Glycerin is a valuable by-

product. Printers, dyers, and textile makers, and many others depend on it.

SCOURING THE WORLD FOR SCENTS

Chemical geography figures, too, in gathering perfume for soap. Australian sandalwood, East Indian citronella and lemon grass, French lavender, Spanish rosemary, and other scents are imported. To choose a popular perfume for one toilet soap, 17,000 different women were consulted.

This is a long step from the ash hopper and the old black iron kettle that stood in grandfather's back yard. Still longer is the step to the new soapless household detergents which do not form curds and scum in hard water, thus eliminating the old "ring around the bathtub," the sticky stiff hair resulting from the ordinary shampoo, and the dull colors of fabrics washed in hard water.

The cost of these products will always be higher than the cost of soaps due to the complicated chemical process of manufacture. We cannot expect, therefore, the soaps we are all familiar with to be completely replaced.

Beside the ash hopper, on the show girl's old family farm, there stood an icehouse. Now it, too, is almost obsolete. With gas, electric iceboxes, and new freezing fluids, chemistry is slowly quieting the iceman's once familiar morning yell.

In strange places, too, chemical refrigerants now do many other astonishing jobs.

Some South African gold mines got so deep that workmen could no longer endure the terrible heat. Now, by chemical air-conditioning, miners are digging gold at a depth of 8,300 feet. Likewise, at the Magma Copper Mine in Superior, Arizona, cooling plants operate at a depth of nearly three-quarters of a mile.

Motorbus passengers through hot desert dust between Damascus and Baghdad ride in comfort, for the new "desert express" is air-conditioned. In Yankee submarines, chemists give comfort to the crews by actually making air for them to breathe while they work under water.

CHEMISTS WAGE WAR ON INSECTS

Man dare not falter in his grim fight on evil insects that eat his trees and food crops. About 624,300 kinds exist; 79,840 varieties swarm over the United States, of which about 6,000 are pests that form a veritable bugs' underworld of gangsters.

Dr. Lee Strong, Chief of the United States Bureau of Entomology, says that from one pair of aphids and their descendants, if all lived only one year, could come enough insects to fill the Atlantic Ocean. Cubic miles of bugs! A terrifying picture.

Derris roots and pyrethrum flowers we import to make insecticides. But such poisons are inadequate, and not useful in every fight. So chemists make more. One lethal laboratory, when we arrived, was testing a new fly spray. In a closed chamber 1,000 flies had just been locked up. Then through a hole a new fly-killer was sprayed in. After a moment a blast of fresh air was injected, so we could enter the door. Flies strewed the floor.

"Count 'em," ordered the chemist, and a stenographer did, dutifully, using two columns of her book.

"I count 920 dead and 80 paralytics."

"That's good," said the chemist. "We're getting somewhere" (pages 625, 626, 627).

MAN-MADE RAINBOWS AND IMITATION DAYLIGHT

Pitting his wit against the sun, man now makes true daylight, or any colored light he wants. Evolved by General Electric's house of magic, these new fluorescent lamps use peculiar chemicals known as "phosphors."

To get green, let's say, with the usual incandescent lamp, you simply coat your light globe with a green film, or make the globe of green glass. This gives off the green, but throws away all other colors, mostly as heat.

New fluorescent lamps are long tubes, not globes. Chemists coat the inside of these tubes with phosphors; these can change unseen ultraviolet light into visible, longer-wave lengths (Plate X).

These new lamps are unbelievably efficient. In making a green light, for example, they do not throw away all other colors; instead, they convert the ultraviolet almost all into green, or whatever color is desired. In case of some colors, this magic tube lamp gives off 200 times more light than the old-style globe!

Different phosphors can be made to yield different pastel shades. Astonishing effects of broad daylight also come from these tubes. Examine a daylight tube's inside coating with a powerful lens, and you see it as a patch of red, blue, and

Photograph by Harrison Howell Walker

HER EYES MAY BE BIGGER THAN HER STOMACH

Anne nibbles a jumbo stick of candy made from whey by Uncle Sam's Bureau of Dairy Industry. Science says this milk by-product may now go into confections as well as into casein fibers. In Italy and some other lands much cloth is now woven from such fibers, or from a mixture of it with wool.

green disks. These are the phosphors; working all together, they give the effect of pure daylight, for use in offices, homes, schools, libraries, anywhere.

Here also was developed the now famous sodium vapor light, so widely used to bathe congested highway spots, tunnels, and dangerous bridge approaches with bright, golden light.

Audacious man, intent on perfecting his artificial world, actually uses a compound of iodine and quinine now in coating a glass that takes glare from light—even from bright sunlight. "Polaroid," they named this new material. It has been called "the chemical answer to an age-old optical problem."

By use of this new Polaroid glass in headlights and visors, the automobile industry can take most of the glare out of night driving, give you complete road visibility, and reduce the other fellow's oncoming lamps to two soft violet disks, provided his headlights also have Polaroid disks. In spectacles, camera filters, reading lamps, etc., Polaroid glass controls light for new uses.

What is it? In simple words, just a film of tiny needle-shaped crystals containing iodine and quinine, all lying parallel and fixed between two sheets of glass or transparent plastic (page 605).

By such feats man builds his new artificial world.

Daily man imitates Nature. In volcanoes she made obsidian, or glass; but it was in chunks. Now man spins it; from a common glass marble he can unwind a 90-mile filament, finer than spiderweb; or he can twist it and make it as strong as piano wire (Plates V, XII, XIV, and page 623).

Glass wool he can make, too, and now he controls Nature by using his own glass thread or wool in fireproof theater curtains, in insulation, filters, and soundproofing.

Today you also see everyday lumber

Photograph by Willard R. Culver

"NOT CAKES OF SOAP," SHE SAYS, "BUT LACY LEAGUES OF SAPONACEOUS RIBBONS!"

From roller to dryer soap in endless tons runs through Procter and Gamble's Ivorydale works, near Cincinnati (page 627). Boilers here are tall as 3-story houses. Watch trainloads of fats rolling in and you imagine soap enough to turn the whole Great Lakes into foamy suds! Yet they say that the per capita use of soap has long been static!

yield to man-made boards, pressed into any shape desired. Insects may eat ordinary sawed boards, but man now stops this waste with chemistry. He even takes trees or old stumps, digests them, recovers the fiber, and rearranges it to make his own boards that cannot split or stain or rot.

EXPLOSIVE GASES PUT TO WORK

Nature shows her explosive powers in earthquakes, volcanoes, or lightning strokes. Man captures her gases to make powder and dynamite to do his work on dams, canals, roads, and in mines. Before chemists learned this, it took 100,000 men 30 years to build the Great Pyramid of Gîza. Now Grand Coulee Dam, three times as big a job as Gîza, is soon finished, with fewer men.

Pharaoh's workers rolled and carried materials; at Coulee Dam a giant man-made belt hauls mud, rocks, and even rattlesnakes, on a continuous conveyer system; and when a great landslide started, man used chemicals to freeze the mud and stones to stop the slide!

In General Electric's laboratory you see men play with a little metal man, who performs on a whirling round table. They do this stunt to show the power of a new permanent magnet alloy "Alnico." With a piece no bigger than a pea one can lift a heavy flatiron; actually, it can be made to lift 1,500 times its own weight.

Beneath the whirling steel table I saw them place a tiny bit of Alnico; on top of the table they dropped the little metal man. He scrambled furiously, tumbled, sprawled, rolled over and over, but always kept his place just above the magnet, no matter how fast they turned the circular table top.

Du Ponts have made a sponge that never saw the sea bottom; yet it would fool even a fish, it looks so natural. It is from spruce. It can be cleaned and sterilized by boiling

Photograph by Paul Pryor

BOILING HOMEMADE SOAP ON A CHESAPEAKE BAY FARM

First by straining rain water through wood ashes in a hopper, she makes her lye. In this she boils her fat, saved from hog-killing time and other domestic sources (page 627).

and won't crumble. Yet it will absorb twenty times its own weight of water. Here are nice soft mattresses, too, and seat cushions made of imitation rubber and blown up like a soufflé pudding!

At Procter and Gamble's you may even see chemists "fingerprint" a slice of cake to study its texture after baking with certain cooking fats.

Like soap (page 627), legend says that glass was also found by accident, when Syrian campers lit a fire of seaweed on the beach.

Perkin, as we've told, was hunting synthetic quinine when he found the first coal-tar dye (page 608).

Now comes the U. S. Patent No. 2,115,886, for a novel color-photography process. Instead of ruled screens or starch grains, this color filter is made from the differently dyed blood corpuscles of sheep.

Even the children are at it. Toy chemical sets, played with by fascinated boys and girls, make smoke, smells, and bubbling magic in a million homes. In countless classrooms other groups stain their clothes and fingers monkeying with test tubes and tiny bottles. No branch of science holds more devotees, or more portent for tomorrow.

NEARLY ONE-FOURTH OF INDUSTRY IS CHEMICAL

Across our country more than 2,000 research laboratories are busy; membership in the distinguished American Chemical Society, as I write, is about 22,245.

Chemical engineering makes one great factory of the whole United States. We produce half of the world's supply of chemical products.

No other country makes more new things by synthetic chemistry. Dr. Stine, of the du Pont firm (page 601), estimates that since the World War there have come from our laboratories more than 200,000 products entirely new to man. Work with only a few of these has revolutionized the methods and

products of more than a score of vast industries, and brought changes to perhaps 40,000,000 jobs.

"At least one-third of all things our factories now make were unknown in 1880," says Dr. E. R. Weidlein, Director of the Mellon Institute, at Pittsburgh. "New industries, such as the automobile, aircraft, radio, refrigeration, air-conditioning, and synthetic fiber, are children of science that are being continuously strengthened by research."

CHEMISTRY AT YOUR STEERING WHEEL

From your plastic steering wheel on your car to your small girl's doll head, you see the works of synthetic chemistry. Less obvious is synthetic chemistry's magic in the fields of oil refining and the making of new gases, acids, and alcohols. Consider your own automobile. It works, almost perfectly, but only because of years of chemical research on antiknock fuels, special lubricants, brake fluids, durable tires, antifreezes, lacquer, safety glass, etc.

Today we live knee-deep in that scientific romance fictionized by Jules Verne in *Twenty Thousand Leagues Under the Sea* and other yarns. Yet even the fertile-minded Verne could hardly have imagined that New York fashion show girl, in all her chemical costume, stepping into a roadster equipped with radio, hydraulic brakes, and Polaroid headlights.

Yet, to us today, such miracles are commonplace.

How far we've come in chemistry since colonial Jamestown's first chemical industry made pitch, tar, and soap ashes, and glass beads for the Indian trade; or since that first of all United States patents was issued in July, 1790, to a Philadelphia chemist for a new way to make sulphuric acid! (Page 626.)

Colonies belong to empire. Egypt had them; so did Rome; then Portugal, Holland, Spain, England, France, Germany, Japan. By this form of government economy kings gained colonies with which they might trade their finished goods for food and raw materials found where Nature produced them. After the Industrial Revolution and the rise of the Machine Age, this process gained more momentum.

In such oversea competition for raw material sources often lay the germs of war. Indubitably, ancestors of the fashion show girl sometime helped some king, somewhere, fight for oil, ores, hides, slaves, spices, fibers, food—or gold.

Today in the Power Age, synthetic chemistry tends to diminish the dependence of nations on colonial raw materials. Man's complete conquest of matter is, of course, an ideal only of fancy. Some nations will always have to import food, and certain raw materials, just as we forever may trade finished goods for certain things we need and which our chemists may never make.

Yet each year sees some new synthetic, some dislocation of older sources, older jobs, and older trade routes. Germany makes "Buna" rubber, motor fuel from lignite, sugar from pine trees. England's great Imperial Chemical Industries, Limited, works to free her from shortage of many natural things. Japan, we hear, makes airplane motor grease from fish and a new dress goods from seaweed.

VEGETABLES IN "WATER GARDENS"

Even farming, we know, is a chemical business which mixes air, water, sunshine, and salts to make starch, sugar, gums, and oils. So now nutritious vegetables grow in trays of water and chemicals—without soil; chemists mix farm-crop alcohols with gasoline to make new motor fuels. Trainloads of corn go into chemicals; soy beans, into oil and plastics.

Profoundly, with infinite pains, science seeks still more new uses for farm surplus. Change is incessant, inevitable. "The only perpetual motion is the growth of truth."

No limits appear, for imaginative man, in his drive on the unknown. Prodigal he is in waste of Nature's gifts; compensating, too, in his genius for finding new uses for them—and creating new things that Nature forgot.

© National Geographic Society Kodachrome by Willard R. Culver

HE JUDGES DYED YARNS FOR STRENGTH AND SHADE

At a glance he can identify some 1,700 different variations of color! Such men, when thoroughly trained, become so expert that their eyes are recognized, in the dye world, as more accurate in color testing than any machine now known.

TESTING WHISTLES IN SINGING KETTLES IS THIS GIRL'S SOFT JOB

Through a tube, she feeds air pressure into the aluminum kettle, with a whistle over its spout. If no pleasant sound issues, or if the result is cacophonic, a new whistle is put on.

© National Geographic Society

Kodachromes by Willard R. Culver

NOW INVISIBLE ULTRAVIOLET RAYS ARE CHANGED INTO COLORED LIGHTS

These new fluorescent lamps give 50 to 200 times as much colored light, per unit of energy used, as do ordinary incandescent lamps. A "white fluorescent" permits the closest approach to natural daylight ever invented.

TOUGH BEEF BECOMES TENDER BY EXPOSURE TO ULTRAVIOLET RAYS

Each year the United States eats nearly 4,000,000 tons of beef, much of it tough. Now Dr. M. D. Coulter, of Mellon Institute, has found this new way to tenderize it quickly.

© National Geographic Society Kodachromes by Willard R. Culver

WITH BRISTLES NOW MADE OF COAL, SIBERIAN WILD HOGS GRUNT IN GLEE

"Nylon," du Pont's mysterious new textile, is formed and hardened into durable toothbrush bristles. Here in a shop at Leominster, Massachusetts, a machine punches holes in the brush handle, sets the bristles, and fastens them (Plate XIII).

© National Geographic Society

AS TEA MELTS SUGAR, NITRIC ACID DISSOLVES SILVER

Five tons of silver are used each week at Eastman Kodak's factory in Rochester, New York. Left in the tank, when the bars are fully dissolved, is silver nitrate in solution; it goes into making film and paper emulsions.

Kodachromes by Willard R. Culver

TESTING SPUN GLASS FOR USE IN SHOE SOLES

Today "Fiberglas" forms an outstanding material in almost every industry. Here this new product is being utilized as a sole filler to provide shoes with insulated, cushioned treads and to make soles more flexible.

© National Geographic Society

Kodachrome by Willard R. Culver

FROM COAL, AIR, AND WATER, SCIENCE PRODUCES THESE SOFT, DIAPHANOUS STOCKINGS

Known as "Nylon," this amazing fabric is not imitation silk, but an entirely new material, developed by du Pont after years of research. Strong, durable, and elastic, it seems destined to have a profound effect on the world's long-established silk industry (Plate XI).

"CAREFUL! WOULD YOU SAY THAT PERFUME IS NATURAL—OR ARTIFICIAL?"

If she says "natural," she's wrong, for the flowers shown are lilacs, and no lilac perfume was ever obtained till chemists made one synthetically, as shown in this du Pont laboratory, at New Brunswick, New Jersey.

© National Geographic Society

Kodachromes by Willard R. Culver

PRODUCTS OF A MAN-MADE SPIDER

Filaments of glass, less than 1/15 the diameter of a hair, are drawn from 102 tiny holes in an electric furnace. These wisplike threads are then wound on spools revolving at mile-a-minute speed.

HERE A CHEMIST TESTS THE EFFECTS OF LIGHT ON DYES

The instrument in a Deepwater, New Jersey, laboratory simulates sunshine. It accurately brings out the fading or nonfading characteristics of a dye, but is constant and shows results faster than would sunshine.

© National Geographic Society Kodachromes by Willard R. Culver

IN LABORATORY EXPERIMENTS MEN ARE "FOREVER BLOWING BUBBLES"

Equipment shown here is for testing and precipitation of dyes soluble in water. Such dyes, known as "lakes," are used to color paint, varnish, printing ink, lacquer, and wallpaper.

NOT A ROPE TRICK, BUT A NEW INSULATION MATERIAL

"Flamenol" is much used for wrapping wires and cables. Made by General Electric chemists, it is strong, durable, flame-resistant, and unaffected by oils or mild acids. Use of different colors makes it easy to trace circuits.

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Kodachromes by Willard R. Culver

GRACEFUL, GLISTENING NEW STEERING WHEELS MADE OF "LUMARITH"

On the bench beside the wheels, in Celluloid Corporation's factory, are shown the molding materials—cellulose acetate, cotton linters, acetic acid, and water—from which these light but stout wheels are made.

THE NOMADS OF ARCTIC LAPLAND

Mysterious Little People of a Land of the Midnight Sun Live Off the Country Above the Arctic Circle

By Clyde Fisher

AMONG the far mountains and rivers of northern Scandinavia, above the Arctic Circle, wanders a mysterious race of people known as the Lapps. Where they came from or who their ancestors were, are matters of debate.

Small in stature but of surprising courage and endurance, most of these sturdy little people are ever on the move. Through whirling snows of the Arctic, up steep mountain passes, through icy rivers, year after year they follow the migrations of their reindeer, upon which they depend for their livelihood.

REINDEER RULE IN LAPLAND

Here we find the usual order of things reversed, man's life being ruled by an animal's needs. The reindeer is the basis of Lappish life. Since verdure in even the best pasturage fields is scanty, the reindeer do not stay long in one place; therefore, few Lapps have a fixed abode and they build no towns. To see how these people, living as their ancestors have lived from time immemorial, meet the problems of life in the inhospitable Arctic is a fascinating adventure.

All the Lapps may be divided into three groups: the poorer sedentary Lapps, who make a living chiefly by fishing; the mountain Lapps, who carry on reindeer culture; and the forest Lapps, who live in the forest district and have settled down to a large extent with their reindeer herds (page 656). There are numerous tribes, which can be distinguished by the shape and color of their caps. Within the same tribe the men's caps are usually different from the women's.

On a late spring day Carveth Wells and I found ourselves on a long, narrow lake well above the Arctic Circle. A pile of miscellaneous baggage lay in the bottom of the little old Finnish boat—cameras and films, food, and gifts for the Lapps.

We had come to Arctic Lapland on a photographic expedition for the American Museum of Natural History, to make still and motion pictures of the everyday life of the Lapps, so different from our own; to carry back to our civilization a glimpse of the courage and grit of a people carrying on in the face of tremendous odds (Plates I-VIII).

With us as guide and interpreter we were fortunate in having Dr. Erik Bergström,* inspector of the nomad schools of Swedish Lapland, who passed eight months of every year in this Arctic country. His integrity of character and sympathetic interest in the Lapps had won for him the confidence of these mysterious people.

Across the spring heath, bright with the shining yellow of butterballs and the waxy white of dwarf dogwood, rose low, snow-covered mountains, pink in the morning sun. It was a brilliant and unforgettable scene.

Close at hand was a sight that interested me even more. On the shore of Lake Kårtjejaure squatted a small, conical, blackish Lapp tent, or *kåta* (pronounced "kawta"; cf. *cottage, cote*)—the first Lapp dwelling we had seen, and the only habitation for miles (map, page 645). Blue smoke curled invitingly from the wide smoke hole.

DON'T KNOCK, THE DOGS WILL ANNOUNCE YOU!

"I should like to call on this family and make some pictures," I told Dr. Bergström.

"Certainly, if you wish," he replied. "You won't even need to knock, for the dogs will announce you. In fact, it is not customary in Lapland to knock at the door."

Suddenly I felt diffident at the thought of intruding upon these strange people, uninvited and unannounced. To be sure, I had come more than 5,000 miles over land and sea to become acquainted with them and to study their customs, but how did I know that I would be welcome? How ought I to behave when once inside the kåta?

As if he guessed my thoughts, Dr. Bergström went on: "You will find the Lapps

* Doctor Bergström gave his life in the service of the Lapps. Some time after this account was written he was caught overnight in a blizzard while on a journey to the schools. He died of an illness caused by the exposure.

Photograph by Clyde Fisher

HER TRUSTY LAPP DOG GUARDS LITTLE JOKKMOKK WELL

When the author tried to shake hands with the child, as he had done with older members of her family, the dog seized his wrist and growled, warning the visitor that such liberties were forbidden. "The dog did not mean to bite you, but only to protect the baby," explained the father (page 653).

seated on the floor around a central fire, for theirs is for the most part a floor culture. Usually they have no tables, chairs, or elevated beds. When you enter, shake hands with each Lapp in the tent, and say to him, 'Pourist! Pourist!' That is Lapp for 'I greet you! I greet you!'

A CALL ON A LAPP FAMILY

"Be careful not to walk behind the fire; that is, on the side of the fire opposite the door, because they keep their food in that place, and from time immemorial that part of the kåta has been a sacred place."

We landed our boat within a few rods of the tent and observed on close view that the kåta resembled the tepee of some of our American Indians. The smoke hole was much larger, being about five feet in diameter, large enough to let in a great deal of rain if occupants did not cover it more or less completely at such times.

The dogs soon discovered us, and four black fellows came out from under the sides of the tent, barking loudly. However, we felt that they were not really dangerous, and, although no human being appeared, we marched boldly to the kåta, lifted the door flap and walked in.

The people in the tent showed no surprise at our entering their home in so unceremonious a manner. Four Lapps were seated around a fire in the center of the tent: one very old woman with gray hair and wrinkled, weather-beaten face, two young men and a young woman—her three children. They looked at us with some slight show of interest, and soon we were exchanging "Pourists."

After we had shaken hands all around, I looked about curiously. The tent cloth was a lightweight woolen material. The floor was covered with 8 or 10 inches of fresh twigs, which made a soft, springy carpet, slippery and hard to walk upon. There were several reindeer-skin bags on

Photograph by Borg Mesch

BY REINDEER OX AND SLEIGH, WOOD COMES TO JUKKASJÄRVI

Lapps train the animals for draft and pack work, but only small children ride on their backs. Reindeer are not strong enough to support grownups. This sled is more conventional than the migratory Lapp's *pulka*, which has only one runner (page 656). The driver controls the reindeer with a single rein, attached near the base of the antlers.

Photograph by Clyde Fisher

A LAPP MAIDEN'S ALPINE STAFF MARKS HER GRAVE IN ARCTIC WASTES

The author's porters, crossing the rugged terrain, pause at the bowlder-covered resting place of the girl, who was drowned while crossing a swollen river during spring floods.

Photograph by Borg Mesch

EVERY ADULT MEMBER OF A LAPP FAMILY CARRIES PART OF THE TENT ON MIGRATION

These nomads are moving camp, ready to follow their reindeer to new feeding grounds. Even in the best fields above the Arctic Circle pasturage is scanty, so the reindeer must constantly move on, and the Lapps follow the animals (page 641).

Drawn by Ralph E. McAleer

LAPPS AND THEIR REINDEER RANGE EUROPE'S FROZEN NORTH, FROM THE NORWEGIAN COAST TO THE WHITE SEA

More than half of Lapland lies above the Arctic Circle. The vast region of ice, snow, and sparse vegetation extends over the northern tips of Norway, Sweden, Finland, and the western part of the U. S. S. R., and has no political boundaries of its own. Here unbroken sunlight lasts for several months in the summer, with corresponding periods of darkness in winter. Life centers about the large herds of reindeer, which the nomadic Lapps follow from one feeding ground to another.

Photograph by Borg Mesch

AT THE FOOT OF MOUNT KERON, NEAR TORNE TRÄSK, REINDEER FIND WELCOME SUMMER PASTURES

The feeding grounds are eight miles from the Abisko Hotel, mecca for summer visitors to the Arctic (page 668). In winter, the reindeer nose through the snow to find their forage. When an early autumn thaw, followed by a freeze, coats the ground with ice in advance of the heavy winter snows, then starvation threatens the animals, for they cannot penetrate the snow-covered blanket of ice to reach their forage.

LADEN WITH FOODSTUFFS, A REINDEER TRAIN PLODS OFF TO THE MOUNTAINS FROM KIRUNA

Photographs by Borg Mesch

ACROSS FROZEN LUOSSAJÄRVI, AT KIRUNA, LAPP AND FAITHFUL DOG FOLLOW A MIGRATING HERD OF REINDEER

The animals may belong to half a dozen families. Ownership is established by the identifying notches cut into the ears of each reindeer when it is a calf.

Photograph by Marvin Breckinridge

PUP LOOKS ON AS HIS MISTRESS CLEANSES A REINDEER HIDE

After washing the skin, the Lapp girl stretches it on a rough board and applies the scraper. When a reindeer is killed, every part of the carcass is utilized. Meat is smoked and dried, or sold frozen for shipment to Norway and Finland. Brains and liver are boiled and eaten fresh. Lungs and blood are food for the dogs.

the floor to serve as chairs, and birch-bark cases somewhat like our suitcases, used for storing and carrying various articles. A few pots and pans completed the equipment.

Both the men and the women wore long coatlike garments trimmed with bands of bright cloth.

The daughter, Inka, was busy roasting coffee in an iron kettle swung over the fire, stirring the coffee beans with a stick. With true hospitality she laid aside her work soon after we entered and hung a kettle of water over the fire to make coffee. The Lapps are coffee drinkers and always serve the beverage to their guests.

I sat down cross-legged, as I often do in camp, and listened to Dr. Bergström speaking to our hosts in Lapp. Suddenly he turned to me with an amused smile and said, "Dr. Fisher, these Lapps think you understand what they say!"

I was astonished, for I knew only two words of Lapp—*Pourist* and *Hyvästi* (Goodby). I had already practiced my "How do you do?" when we entered, and was now trying not to forget my other word before we should take our leave.

Laughingly I asked, "Why do they think I understand their language?"

"They say you sit like a Lapp and you look like a Lapp."

I now noticed that the girl was washing apparently clean cups in hot water before serving us.

"Why is she doing that?" I asked.

Doctor Bergström explained that cups are always washed by the Lapps both before and after use. This was one more process than I was used to at home, and the explanation removed any doubts I might have had about sanitary conditions.

Inka raised the lid of one of the birch-bark cases in the back of the tent and

Photograph from Mrs. Alexander Graham Bell

FATHER LASSOES THE REINDEER, MOTHER DOES THE MILKING

The reindeer cow is not so tame as domestic cattle and must be roped. As accurate with the lasso as a western cowboy, the Lapp always hurls it while afoot. Then the protesting cow is pulled in, hand over hand, and held with the improvised halter. The rim of the dipperlike wooden bucket curves inward to keep the milk from splashing should the cow kick (page 653).

Photograph by Clyde Fisher

MOUNTAIN BUTTERCUPS BLOOM IN THE MIDNIGHT SUN OF ARCTIC LAPLAND

The author made the photograph in mid-July at 1:30 a.m., on the slopes of Mount Njulja, near Abisko. The Lapps call the succulent plant the "reindeer flower" (*Ranunculus glacialis*), because in summer the reindeer feast upon it high on the mountainsides (page 669).

Photograph by Marvin Breckinridge

A LAPP FAMILY OF FINLAND SUBSTITUTES FARMING AND SPINNING FOR REINDEER MIGRATIONS

Differing from the nomadic mountain stock, the forest Lapps have permanent homes and engage in fishing and agriculture (page 641). This home, near Kaamanen, is similar to that of other Finnish farmers of the region.

Photograph by Borg Mesch

STORGLACIÄREN, VAST SWEDISH GLACIER ON MOUNT KEBNEKAISE, IS 130 FEET HIGH AT THE WATER'S EDGE

Photograph by Borg Mesch

TOO HIGH FOR CHILDREN OR DOGS TO REACH—AN AL FRESCO LAPP PANTRY

The storehouse for the family's supply of dried reindeer meat and other provisions is an elevated platform of sticks, built close to the tent (page 655).

drew out a little old-fashioned coffee mill. Seating herself beside me on one of the rolled-up reindeer skins, she held the mill on her lap and ground the coffee, just as I had seen my grandmother do when I was a boy.

After the coffee had been sufficiently boiled, Inka opened a reindeer-skin bag, drew out a dried fish, and pulled off a piece of fish skin which she put into the pot, scales and all, to settle the coffee. After this, a few coarse crystals of salt were added, I suppose to improve the taste, and at last the coffee was ready to serve.

PINCERS FOR A SUGAR LOAF

Inka poured it into cups fashioned of northern white birch in the shape of small dippers and beautifully hand-decorated with primitive designs. These were passed around on a long, narrow, rectangular wooden tray, similarly decorated. I later found that these trays were characteristic utensils of all the kåtas I visited.

To my surprise there was sugar for the coffee, not granulated and not in little blocks, but in a large conical loaf as large as a small loaf of bread. From this the Lapps broke off a piece for each cup with a specially devised pair of pincers.

I put my piece of sugar in my cup of coffee and stirred it as I would at home, but each Lapp placed the lump of sugar in his mouth and drank his coffee through it with a loud sucking noise. Cream there was, too, in the form of goat's milk, heated to remove objectionable aroma.

Knowing that the reindeer was highly prized by the Lapps both for its flesh and for its milk, I asked Dr. Bergström why they used goat's milk.

He replied, "The Lapps are using goat's

milk more and more and reindeer's milk less and less because it is more convenient to keep two or three goats that are willing to stay near the kåta, living if need be on the very sparse pasturage, than it is to go off a mile or so up the mountains to milk the roving reindeer (page 671).

"Another consideration is that the female goats are more docile than the reindeer cows, which have to be lassoed before they can be milked. Then, too, a female goat gives much more milk than a reindeer cow, although the goat's milk is not so rich."

The hospitality of these Gällivare Lapps was delightful, but the coffee left much to be desired, in spite of Inka's elaborate preparations. The Lapps buy the cheaper grades of green coffee and roast it themselves. However, one is not fastidious about coffee or anything else in the Arctic.

"Well," said Dr. Bergström finally, "we must be on our way."

We shook hands with each member of the family as we had when we came in, but this time we said "Hyvästi! Hyvästi!" —the word I had been trying so hard to remember.

Inka and her two brothers came out of the kåta to see us off and permitted us to photograph them. This was a concession, since the Lapps are averse to being photographed because of religious scruples and superstitions. It was only by Dr. Bergström's influence throughout Lapland that we were able to obtain the pictures we sought.

LAPP GIRLS LIKE BRIGHT COLORS

As a mark of appreciation we presented Inka with a strip of red military cloth. This is highly prized by the Lapps for trimming their coats, dresses, and caps. It is difficult to obtain in Lapland and quite expensive. Knowing this, we had laid in a supply in Copenhagen, tearing it (not cutting it) into strips as wide as we could span between thumb and little finger.

The strips were torn crosswise of the bolt, so that each strip was about eight inches wide and slightly more than a yard long. Although the Lapps are an undemonstrative race, Inka thanked us with a smile and was evidently pleased.

We went down to our boat and pushed off. When we were a few yards from the shore, the three Lapps waved their arms and called to us quite distinctly, "Goodby! Goodby!"

Doctor Bergström laughed at my astonished question.

"These Lapps came to me privately," he said, "and stated that you had said 'How do you do?' and 'Goodby' to them in their language. They asked me how they might say goodby to you in your language. They are merely showing their characteristic fine courtesy and kindliness."

I was eager to visit members of another tribe to compare them with the Gällivares who had just entertained us. For this reason, when about three o'clock we spied another telltale column of smoke at the head of Kårtjejaure, I could hardly wait to get to shore.

"This is the home of a Lapp family belonging to the Jokkmokk tribe," Dr. Bergström told me. "Perhaps they will put us up for the night."

The ever-present dogs again announced our approach. Feeling more confident, we boldly entered, to find a family of father, mother, and five children seated on the floor around the fire.

THE DOG GUARDS THE BABY

They, like the Gällivares, showed no surprise at their unexpected callers. No one rose as we entered, but they greeted us in Lapp and held out their hands in friendly manner. The mother explained to Dr. Bergström that her eldest son was away in the neighboring mountains, caring for the reindeer.

I shook hands with the adults and elder children, but when I came to the youngest, a baby girl most cunning in her Lapp dress and boots with turned-up toes, and attempted to take her hand, an old black Lapp dog that had been lying beside her snapped my wrist between his jaws and held it with a growl which plainly told me that I should not touch the baby.

Although surprised, I was not hurt, for the dog's teeth had not broken the skin. Noting its action, the adult Lapps quickly slapped the dog away, with words which sounded like scolding (page 642).

The father spoke to Dr. Bergström, who explained to me, "The dog did not mean to bite you, but only to protect the baby. This is his prescribed duty. You can see he did not draw blood."

I asked Dr. Bergström to assure the mother and father that I was neither injured nor offended. Later I learned that it is a common custom in Lapland to have an

Photograph by Clyde Fisher

STILLED IS THE MAGIC DRUM OF THE LAPPS

Linnaeus, famous Swedish botanist, found the relic, with reindeer hide drumhead, when he visited Lapland in 1732. Now it is on display in the National Historical Museum in Stockholm. When the Lapps embraced Christianity in the 18th century, they destroyed their drums (page 676).

old, dependable dog trained to take care of the baby, since the mother has so much work both inside and outside the tent.

We joined the circle around the fire, seating ourselves upon reindeer skins supplied by the Lapp mother. Here we visited for awhile, watching with much interest everything that was done. No doubt we were as interesting to these people as they were to us.

I wished to reload my camera, and I am sure I must have cut a strange figure with both arms up to the elbows in a black bag. The Lapps, while evidently interested, were too innately polite to stare at me or to notice openly what I was doing. In this respect they are much like the American Indian, who is too polite to stare or appear curious, no matter how strange a figure you may present.

THREAD OF REINDEER SINEWS

The mother was making thread of reindeer sinews. The tendons were separated into slender strands, which she rolled against her cheek and drew between her teeth. The sinew thread is very strong. It is used chiefly in Lapp boots, which are waterproof when sewed with reindeer sinews. The eldest daughter and a Lapp woman caller were plaiting shoebands of bright red and yellow woolen yarn.

We had not been in the tent long before the mother made tea for us, and excellent tea it was. Perhaps this was in deference to my English companion, Mr. Wells. I do not know. We drank the tea with goat's milk.

Night was approaching, although the sun was still shining brightly. In fact, the sun was never out of sight day or night during our journey in this land. Even at midnight, when the sun was low on the northern horizon, there was enough light for me to take pictures.

Doctor Bergström asked the mother if she could keep us for the night. There was ap-

parently no hesitation whatever in extending hospitality in this humble home. It was delightful—no hurried trips for extra provisions, no hustle and bustle about the house. The family was ready to share its simple comforts with strangers at a moment's notice.

Our hostess merely went outdoors to her pantry, an elevated platform of sticks where she kept her dried reindeer meat out of reach of the dogs, and brought in an extra piece of venison (page 652).

We had a delicious dinner of reindeer meat, smoked with the fragrant dwarf juniper, wild golden mountain raspberries, and ember cakes made of barley meal and water and baked in a shallow, open frying pan set up on edge in front of the hot coals. These ember cakes, though much tougher, reminded me of the hoecake of our Southern States.

Photograph by Clyde Fisher

ONTO THE MAGIC DRUM WENT RINGS AND TWIGS

Hand-carved is the hollow block frame for the drumhead (opposite page). *Noaides,* or sorcerers, gathered about the instrument to mutter incantations, grind their teeth, and tap the drum. During the tapping, the small objects placed on the head shifted from their original positions. The new locations of the rings and twigs on the drumhead held mystical meanings.

THE AUTHOR LEARNS TO EAT WITH HIS KNIFE

At this meal coffee was served with a little cube of reindeer cheese instead of milk or cream. The Lapps sliced off slivers of the reindeer meat with their knives, and then skillfully conveyed the morsels to their mouths between knife and thumb, meanwhile turning the knife so that the back of it touched their lips. It seemed as easy for them to do this as it is for us to use a fork or spoon, and I was soon imitating them and eating with my knife.

Dried reindeer meat, prepared in Lapland and smoked with dwarf juniper, now is seen in Swedish delicatessen stores in New York and in other American cities. Also imported are golden mountain raspberries (*hjortron*) and mountain cranberries (*lingon*).

The Lapps who migrate with their reindeer have no time to engage in gardening

or in agriculture. Their vegetable food is limited to a few wild berries and to a few plants, of which they eat the stems or leaves or both. The food of the migratory Lapps is largely animal. The article of food ranking next below reindeer meat in amount consumed is fresh fish, about a half dozen kinds being caught and eaten. We were especially fond of the black-spotted trout.

Soon after this excellent meal our hosts prepared to retire for the night. The central fire was banked; and the reindeer skins, which had been rolled up to serve as seats during the day, were unrolled for beds. The family's beds were spread on the floor on one side of the fire, and ours were on the opposite side. There are no partitions or divisions in the tent, but one half of it was always assigned to Mr. Wells and me for sleeping, regardless of the number of persons in the Lapp family.

Our hostess indicated our pile of skins, and we wasted no time in turning in, pausing only to remove our coats and boots. The reindeer-skin bed was surprisingly comfortable. The skins, covered with thick hair two or three inches long, were soft and warm, and the fresh carpet of twigs underneath acted as excellent springs.

Soon asleep, I knew nothing more until I was awakened in the morning by the Lapp mother moving about the tent, and by the welcome aroma of coffee. Like all good Lapp wives, she was the first of the family to rise so that she could uncover the embers and kindle the fire afresh, make coffee, and serve it to her husband in bed.

This morning, maintaining her courteous hospitality, she served coffee to us before she did to her lord and master. Unaccustomed to such luxury, Mr. Wells and I awkwardly sat up amid our reindeer skins and drank with enjoyment, for the early spring is frosty in the Arctic.

After breakfast we prepared to leave. To our kind hostess we gave two lengths of the precious red cloth, then shook hands all round, and said, "Hyvästi!"

Assuming that the dog had been made to understand that we were accredited guests in the household, I again attempted to approach the baby; but before I reached her hand the dog snapped me again by the wrist, growling as before.

The mountain Lapps, the nomads proper (page 641), are entirely engrossed in reindeer culture, and are all migratory. On our journey we saw little of the forest Lapps, who stay in the forests the whole year round. Their reindeer are different from those of the mountain Lapps, being larger than the mountain reindeer. While forest Lapps engage in reindeer culture to a considerable extent, many find time for agriculture as well as fishing (page 650). We gave our attention to the nomadic mountain Lapps, who live almost wholly upon their reindeer.

Besides the flesh, the milk of the reindeer is an important article of food. It may be drunk when fresh and sweet, eaten with wild berries, or dried, or made into cheese. The milk contains much fat, but butter is not made by the Lapps.

REINDEER LASSOED FOR MILKING

Although the reindeer belong to the Lapps, they are not so tame as the domestic cows of our barnyard, and each reindeer cow must be lassoed before milking. The Lapp handles the lasso as expertly as does our western cowboy. He can throw the rope as far and as accurately, but he always does it while on foot.

After lassoing a cow, the Lapp draws her up to him hand over hand, then makes an improvised halter of the rope, which he holds while his wife does the milking (page 649). The milk bucket is a large dipper with a handle, all in one piece, carved from a burl of northern white birch. The rim is curved inward to keep the milk from splashing out should the reindeer cow kick during the milking.

The reindeer skins are used for boots and trousers, and for coats and dresses, as we might call them. In winter the tuniclike coats or outer garments of the men and women are worn with the hair inside; in summer they are worn with the hair outside. However, in the parts of Lapland we visited, nearly all of the Lapps wore outer garments made of heavy woolen cloth, and all of the caps were made of cloth.

When used for trousers and for many other purposes, the reindeer skins are dehaired as well as tanned. The skins are floated on the water of a lake until the hair begins to slip, when it is easy to remove it. Then the skin is rolled up with the inner bark of the white birch, the tannin of which changes the raw skin to leather.

In winter the reindeer are used as draft animals, a peculiar sled called a *pulka* being drawn over the snow by a single reindeer ox (page 643). The sled, which has a single runner, is shaped like the bow of a

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Kodachrome by Kuhne, Movietonews

BURLY DEER HERDSMEN WEAR PINK HATS AND TUNICS TRIMMED WITH RIBBONS

Heavy clothes for a warm July day are the thick wool shirts and reindeer-skin trousers and boots worn by these nomads camped for the summer at Kautokeino, in Norway. Throughout a broad region known as Lapland, extending across the top of Norway, Sweden, Finland, and Russia's Kola Peninsula, hardy Lapps of many tribes follow their vast herds of grazing reindeer.

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Kodachrome by Kuhne, Movietonews

GARBED LIKE COURT JESTERS, LAPP MEN SEEM TWINS OF THEIR WIVES AND DAUGHTERS

Cloth flaps dangle from men's hats in the Repparfjord district of Norway. Lapps once inhabited regions farther south in Scandinavia, Finland, and Russia; other peoples pushed them into the far north. They are not directly related to any present-day European race, and their place of origin is uncertain.

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"HURRY, MOTHER, I WANT A LOOK, TOO"

A Lapp wife inspects her country through the eye of the photographer's motion-picture camera. Women often don several tasseled silk shawls at once. The boy wears a deerskin jerkin.

Kodachromes by Kuhne, Movietonews

LIFE BELTS ARE STUFFED WITH BUOYANT REINDEER HAIR

Each strand is a hollow, unsinkable tube. The fur is also used to fill pillows, pads, and mattresses. Here a Lapp woman picks soft, white throat hair in a *pulka,* or reindeer sled, resembling a shallow canoe.

CAMPGROUND TURF IS THE RING FOR A FRIENDLY TUSSLE

During sunlit nights of Arctic summer the hollow pile of brush affords a cool place to sleep. A cloth tent stands behind. The dozing dog helps herd the reindeer.

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Kodachromes by Kuhne, Movietonews

IT'S EASIER TO GOSSIP WITH THE HAT FLAPS UP

In chilly weather they can be tied snugly under the chin. Numerous gay scarfs help protect a mother, son, and daughter from the summer plague of mosquitoes and gnats.

THE LAPLANDER'S "SUMMER PALACE" IS A SNUG SOD HUT

Heavy stones prevent winds from raising the roof. The boys doing chores belong to the Kautokeino tribe, which follows the reindeer herds north and west in summer.

© National Geographic Society Kodachromes by Kuhne, Movietonews

NOT A TAFFY PULL!—MOTHER AND DAUGHTER WRING OUT A REINDEER SKIN

The hide has just been dipped in a tanning solution. Besides pulling sleds, domesticated reindeer provide meat, skins for garments and boots, antlers and bones for tools, and sinews for thread.

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Kodachrome by Kuhne, Movietonews

CRADLES, LIKE ALL LAPP HOUSEHOLD GEAR, ARE DESIGNED FOR LIFE ON THE MOVE

The baby's rumble seat is fashioned from a hollowed birch log and covered with soft skins. A cloth curtain may be pulled down to protect the child from sun glare and insects. Red pompons on the boys' hats indicate that these Lapps are Swedish. They are encamped for the summer at Lyngsfjord in Norway. A tin roof modernizes the mud hut, behind.

© National Geographic Society

A "SNEAKER"-SHOD HEIR GETS A LIFT AT LYNGSFJORD

Kodachromes by Kuhne, Movietonews

BY HIS POMPON YOU KNOW HE'S A SWEDISH LAPPLING

© National Geographic Society

Kodachrome by Kuhne, Movietonews

EVEN THE CAMP'S GILT-EDGED BEAU BRUMMELL STUFFS HIS BOOTS WITH GRASS

Lapps wear no stockings, but fill their oversize shoes with dry hay, which is easily replaced. Long leather trousers of this Kautokeino dandy are tied with ribbons over the boot uppers.

boat at the front end and is abruptly truncated at the back end. The single tug of the harness is attached to a collar about the reindeer's neck, from which it passes back between the front legs and between the hind legs to the sled. The reindeer is driven with a single line attached to the base of the antlers.

ONLY CHILDREN RIDE REINDEER

On the migration, reindeer oxen (or castrated males) are used as pack animals, each animal carrying a light load fastened on the back by means of a peculiar saddle, the two parts of which link together over the back. The adult Lapps never ride the reindeer, for it is not strong enough to support them. However, the Lapp children are sometimes carried in this way.

Like the caribou, both the male and female reindeer bear antlers. The antlers of the male reindeer, however, are larger than those of the female.*

Not only does castration make the males more docile—an important consideration in pack and draft animals—but it also changes the time of shedding the antlers.

In normal adult males the antlers are shed after the rutting season in the fall; that is, several months before those of the adult females, which shed their antlers after the birth of the calves or fawns in May or June. The oxen sometimes carry their antlers a few months longer, and shed them usually shortly after the first of the year or in early spring. Also the skin is never shed from the antlers, which are always in the velvet.

The greatest enemy of the reindeer is the Lapland wolf, which closely resembles the gray wolf of America. Some of the Lapps have become expert wolf hunters, pursuing the predatory animals on skis.

As a pack and draft animal, the reindeer has at least one advantage over the Eskimo dog, and that is in the matter of food. The reindeer finds its food where it rests (except when near settlements), but the driver of a dog team must take food for his dogs along with him. For the sake of the migratory Lapps, who move from Sweden over into Norway during the short summer, a special treaty is in force between these two countries to insure the pasturage rights of these nomads of the north.

The Lapp dog is a most important animal in the reindeer culture. He is always used as a herder. It is astonishing to see how quickly one of these dogs can bring a stray reindeer back to the herd.

The Lapp dogs are never used as draft animals; in fact, they are as different from the Eskimo dogs as Lapps are from Eskimos. By some scientists the Lapp dog is considered a distinct variety or subspecies.

The great majority we saw were uniformly black, though some were spotted. The handsomest ones were cream-colored and would have attracted attention in any dog show in America. I believe the Lapp dog resembles the Samoyed breed more closely than any other I know.†

LAPP DOGS TAKE TURNS AT EATING

Unlike the Eskimo dogs, Lapp dogs are trained from puppyhood to take turns in feeding, and always in the same order. This is done under strict supervision, and the method insures that every dog gets its share. The main food is a hot soup consisting largely of reindeer blood, all of which is preserved at slaughtering time.

On July 4 we climbed Akavare (Akka), one of the most beautiful mountains of Lapland, about as high as our Mount Washington in the White Mountains. Akavare, however, has several peaks instead of one, and several glaciers, three of which are large.

We began our ascent of the mountain along the milky-colored stream which flows out from Hambergs Glacier, and were interested to note the concentric crevasses in this glacier, which are correlated with the fact that a glacier, just like a river, flows faster in the middle than at the sides.

During our tramping over the glaciers of Akavare, our Lapp guide watched us most carefully lest we fall into a crevasse. Whenever either of us got into a dangerous position, we always noted the Lapp with his alpine staff set to prevent an accident. He seemed to be everywhere at once when the trail was treacherous.

On this trip I came across my first "red snow," the phenomenon frequently mentioned by Arctic explorers. It is caused by a microscopic plant, a reddish alga (*Chlamydomonas* (or *Sphaerella*) *nivalis*), which grows and multiplies on the snow. The snow is hardly red, but it is a decided pink. The tiny plant which gives the red-

* See "Deer of the World," by Victor Cahalane, National Geographic Magazine, October, 1939.

† See "The Book of Dogs," published by the National Geographic Society.

Photograph by Borg Mesch

THEY SHALL HAVE MUSIC WHEREVER THEY GO!

Father has suspended bells from the necks of the little Lapplings. Even if they elude the watchful dog and stray away while playing, the tinkle of the bells will make the children easy to find.

dish color to the snow is closely related to the one that grows abundantly on the bark of trees in temperate latitudes, often forming a continuous green coating, especially upon the lower and more shaded parts of the tree trunks.

After crossing the boundary between Swedish and Norwegian Lapland, we soon came to the head of Hellemofjord, an arm of Tysfjord, which opens out on the Norwegian coast. On Hellemofjord most of the population is composed of Lapps, and these are of the nonmigratory fishing tribes.

I shall not soon forget our descent into this steep-sided fjord, for the heelless Lapp boots which we wore in the mountains were not adapted for climbing down steep slopes kept slippery by a steady rain.

Probably the trouble was with the inexperienced wearer, for the Lapps seemed not to be troubled. One doesn't mind sitting down unexpectedly once, but before reaching the bottom of the fjord the experience had become to me decidedly monotonous.

We passed the night with one of these fishing Lapps at the head of Hellemofjord in a little settlement known as Hellemobotn. Because of the long walk in the rain, as well as frequent wading, my feet were as wet as they could be. I was reminded of the remark of an American naturalist who said, "The higher the boots, the more water they hold."

The Lapps wear no hose whatever; instead, they line the boot, just before pulling it on, with dry grass or hay. To the botanist it is not a grass, but a fine, flexible sedge (*Carex* sp.). We also used this shoe grass in our Lapp boots.

GOATS LIKE LAPP "SOCKS"

Before going to bed, I hung up my shoe grass near the door to drain, perhaps to dry a little. When I rose next morning, it was not where I had left it. All evidence indicated that during the night the goats had eaten my "socks."

Photograph by Borg Mesch

IN MOUNTAIN SOLITUDES OF TORNE TRÄSK A LAPP FAMILY PITCHES CAMP

The hamlet of Pålnoviken lies beyond the arm of the lake at right. About ten miles away is the village of Abisko, where many travelers journey to see the glories of the midnight sun. Lapporten, or Lapp Gate, opens a way through the peaks far in the distance.

Photograph by Clyde Fisher

LINNAEUS, "FATHER OF BOTANY," ONCE WANDERED IN THESE GARDENS

The author visited the cottage at Linnés Hammarby, near Uppsala, Sweden, where the great scientist passed his last summer (pages 668 and 675). Now the humble dwelling is a shrine for naturalists. In the year George Washington was born, Linnaeus explored Lapland, and classified its flora.

Photograph from Clyde Fisher

THE AUTHOR SITS IN THE SEAT OF LINNAEUS

Dr. Fisher poses in the saddlelike stool used by the Swedish botanist when he lectured at the University of Uppsala. The photograph was made outside the little stucco-covered museum devoted to Linnaeana at Hammarby (page 676).

This was the more serious because we had no more of the sedge, and could not conveniently replenish our supply then and there. However, I dug out from our camera supplies some excelsior and used this for socks during the next few days. Knowing the goat's omnivorous appetite, I was henceforth careful of even the excelsior.

We traveled on to Abisko on Torne Träsk where we visited the Swedish Scientific Station. Here meteorologists, geologists, botanists, entomologists, and other scientists carry on research work in the Arctic. I examined a modern seismograph invented by a Russian at this station and was amazed to find how delicately responsive it was. It was especially noteworthy as one of the most northern seismographs in the world. By means of kites, equipped with lightweight recording instruments, there had also been carried on here important research work on conditions in the upper air.

With the Tourist Station at Abisko as a base, I climbed Njulja (Mount Nuolja) three times, once with Dr. G. Einar Du Rietz of the Department of Botany in the University of Uppsala, whose studies in ecology and plant geography are well known and much appreciated in America.

The trip with Professor Du Rietz, who says that Njulja is one of the richest mountains botanically in all Lapland, was made especially for photographing Arctic alpine flowers.

LAPLAND HAS 99 KINDS OF DANDELIONS

One of the most surprising things about the Arctic is the abundance of wild flowers which bloom during the short summer. Another less pleasant surprise was the abundance of mosquitoes over the snow fields. I would brush them from my coffee, but before I could lift the cup to my mouth there would be several more on the surface of the beverage.

Because of the present distribution of Arctic plants, it is believed that some time

in the past there must have been an easier means of dissemination around the Pole than now. Not a single family and scarcely a genus of Arctic plants is known that is not circumpolar in distribution.

In comparing the evolution of certain genera of plants in Sweden and Swedish Lapland with that of eastern United States, I observed some striking contrasts. For example, in Lapland, in fact in all Sweden, there is but one species of goldenrod, whereas in eastern United States there are more than sixty! On the other hand, in eastern United States there are only two species of dandelion; in Sweden there are 99!

Photograph by Borg Mesch

"NO GOOD UNLESS THE WIND'S BLOWING IN HIS NOSE"

So Johan Turi (Thuri), Lapp author, describes his fellow tribesmen from the Jukkasjärvi District. In his *Book of Lappland* he extols the merits of these nomad reindeer herdsmen as they doggedly follow their animals over the high fells of the Arctic, through the fierce winds and driving snows of winter blizzards.

While tramping with Professor Du Rietz, I made photographic studies of butterballs, or *smörboll* (*Trollius europaeus*), which grow in meadows about the upper limit of trees on Njulja. The plant, which grows knee-high, belongs to the buttercup family. The flowers never open out like buttercups, but always keep a globular shape similar to that of the flowers of our yellow pond lily. In English they are sometimes called "globeflowers." The flowers, which are more than two inches in diameter, are bright yellow. A meadow of these is an unforgettable sight.

A true buttercup (*Ranunculus glacialis*) growing on top of Njulja interested me because this succulent plant constitutes the principal food of the reindeer when they reach the highest parts of Lapland. It is called "reindeer flower" (page 649).

From Abisko I crossed Torne Träsk to visit Johan Olafsson Turi, the Lapp author, who has since died. His fascinating book, entitled in English translation *Turi's Book of Lappland,* was the first to be written by a Lapp about his own people, and in recognition of this work he was pensioned by the Swedish Government.

Now too old to migrate with his people and their reindeer, he was living the year

Photograph by Borg Mesch

JOHAN TURI'S "BOOK OF LAPPLAND" WON A GOLD MEDAL FROM SWEDEN'S KING

The venerable Lapp author, first of his race to tell the story of his own people, is shown receiving the decoration in the Jukkasjärvi schoolhouse. Turi, who did not know how old he was, had been a nomad from birth, until advancing years forced him to give up the annual migrations with his tribe. He retired to a cabin in a forest near Torne Träsk and there, with the assistance of a Danish writer, Emilie Demant Hatt, he prepared the volume of Lapp folklore which made him famous. He died November 30, 1936 (page 669 and below).

round on the shores of Torne Träsk, where he devoted much of his time to fishing. We ate a meal with him at his simple home, and found him a fine, likable person and a genial host. He was naïve, and had a strength of character resulting from more than threescore and ten years amid Lapland's mountains.

FOLLOWING A LEMMING MIGRATION

Having heard much of the migration of the lemming in Scandinavia, we were most eager to see this little rodent (page 671).

Its migration occurs every few years, at irregular intervals. The chapter on the lemming in *Mårbacka,* the autobiography of Selma Lagerlöf, gives a vivid picture of its mysterious coming and going.

We were lucky enough to run into the tail end of a lemming migration in the vicinity of Great Lake Fall (Stora Sjöfallet) on the Stora Lule River. First we observed droppings of the lemmings in ever increasing numbers, until they became so numerous that it was almost impossible to obtain clean water even from melted snow.

The lemmings on their migration do not stop for snow or water, or anything else. They even swim out to sea and drown. Soon we came across more or less mummified carcasses, and presently saw the lemmings running across the heath.

They are not much afraid of human beings or dogs, and are extremely pugnacious when cornered. In attempting to frighten a man away, they will jump at him repeatedly, giving a little barking sound at every jump. I could not help admiring their courage, for I never saw one show the white feather.

They are a little bigger than our chipmunk, which they also resemble in color, but the tail of the lemming is so short that one cannot see it as the animal runs about. They reminded me of diminutive guinea pigs, brick red or yellowish red with some black above and light below.

Why does the lemming migrate? There are two theories: the first that, having exhausted its food supply in a certain

SHE PREFERS HER GOAT—IT'S EASY TO GET!

Nanny stays near the tent always, but the Karesuando woman would have to hike up the mountain to reach a reindeer cow, and then wait until her husband lassoed it before milking. In addition to being more docile, goats also give more milk, even though it is not so rich. More and more, the Lapps are turning from reindeer to goats for their milk (page 653).

Photographs by Clyde Fisher

WHEN BABY LEMMING GROWS UP, HE MAY MARCH INTO THE SEA TO HIS DEATH

At irregular intervals through the years, these Scandinavian rodents, about the size of chipmunks, descend in multitudes from the mountains and journey to the ocean, where they drown themselves. They move mostly by night, feeding and sleeping by day. So prolific are these small animals that they actually increase in numbers during their frenzied journey (page 670).

Photograph by Borg Mesch

DIVINE SERVICE OVER, DEVOUT LAPPS TRUDGE BACK TO THEIR HOMES THROUGH THE SNOW

The photograph was made on an Easter Sunday from the belfry of the church in Jukkasjärvi, centuries-old Lapp village near Kiruna (page 674). On March 25, the day of the Feast of the Annunciation, the church always is crowded for christenings, marriages, and funerals. The Lapps come in sledges from all the countryside for the various services. The bodies of many who died during the winter in the mountains are brought down for burial.

Photograph by Borg Mesch

YOUTHFUL NOMADS ATTEND PERMANENT SCHOOLS IN WINTER, BETWEEN MIGRATIONS

Three upper classes are taught here at Killingi, and also at Jukkasjärvi. Lower classes are conducted in the portable Lapp mountain schools (page 675).

Photograph by Clyde Fisher

"SOON YOU WILL BE BIG ENOUGH TO RIDE A REINDEER, TOO, LITTLE BROTHER"

In the meantime, Mother will carry him, cradle and all, slung upon her back (Plate VI). The chubby Lappling's bed is lined with moss and linen, and under his head is a feather pillow. If he gets tired, he probably will find solace in sucking a piece of cooked reindeer fat.

region, it moves out to get food; the other, that it runs blindly because of a disease, perhaps an infectious or contagious bacterial disease. Fitting better with the second theory is the fact that the migrating creature goes until it dies.

I had been commissioned to examine the educational system of Sweden, from the elementary schools to the two complete universities of Lund and Uppsala, the latter founded before Columbus discovered America.

SCHOOLS WANDER WITH THE LAPPS

In carrying out this project, I traveled for several weeks over the country from Skåne in the south to Jämtland in the north. The whole undertaking proved worth while, but none of the schools interested me more than the nomad schools established by the Swedish Government in Swedish Lapland (676).

These nomad schools move along with the Lapps on their migration. School is conducted in a kåta set aside for this purpose just as long as the Lapps remain in one place—a week or ten days or two weeks; then it is moved to the next stopping place on the migration. Teachers are usually Lapp men or women trained in a special seminary at Murjek. Occasionally the teachers are Swedish girls.

The children are given a practical course of study which includes the Swedish language, numbers, local geography, and elementary natural history based upon plants and animals with which they actually come into contact. When reciting, the pupils did not rise to their feet, but to their knees—probably because of the sloping sides of the low tent and the cramped quarters.

After visiting two or three of the real nomad schools, I desired to visit one of the permanent schools which the children attend during the winter when the Lapps are not on migration. This we had opportunity to do at Jukkasjärvi, a Lapp village in Sweden several hundred years old about ten miles east of Kiruna (pages 672, 673).

Before entering the village, we had to cross the Torne River, the outlet of Torne Träsk, a broad peaceful stream here. We hired two Finnish women to row us across in a Finnish boat such as we had frequently seen and used in Lapland.

In the Lapp school at Jukkasjärvi only the three upper classes are held, the three

Photograph by Clyde Fisher

MIGRATORY LAPP PUPILS CAN'T ESCAPE TEACHER—SHE'S A NOMAD, TOO

Schools move from one location to another every week or ten days because children accompany their parents on the annual trek with the reindeer herds. Miss Elisabet Sjulsson, the instructor, traveling with her class, was encountered here at a temporary stopping place near Kvikkjokk.

lower classes being conducted in the nomad schools in the kåtas in the mountains. The permanent schools have excellent buildings and fine equipment provided by the State.

These well-built schoolhouses were painted red and trimmed in white, a color scheme common in Swedish cottages (*stugor*). There were modern desks and seats, good blackboards, charts, maps, pictures, etc. On the walls were hygiene, anatomy, and natural-history charts, and many maps.

We were told that the Lapp children especially enjoy geography, which might be expected because of their migratory habits. There were maps showing the migrations of the Lapps and the districts where they have the right to pasture their reindeer, this material being used for instruction in the course of "nomad knowledge," important to the Lapps and most characteristic study of the nomad schools.

At the time of our visit, in late July, the Lapps were all away on their migration, but we were shown about the school by one of the teachers, a Swede. On one of the blackboards we observed an amusing drawing, very un-Lappish, captioned *Leve de Lappen* (Long live the Lapps!). We were told that it had been made by Princess Juliana of the Netherlands a few weeks before, on a visit of the Queen and her party to this school.

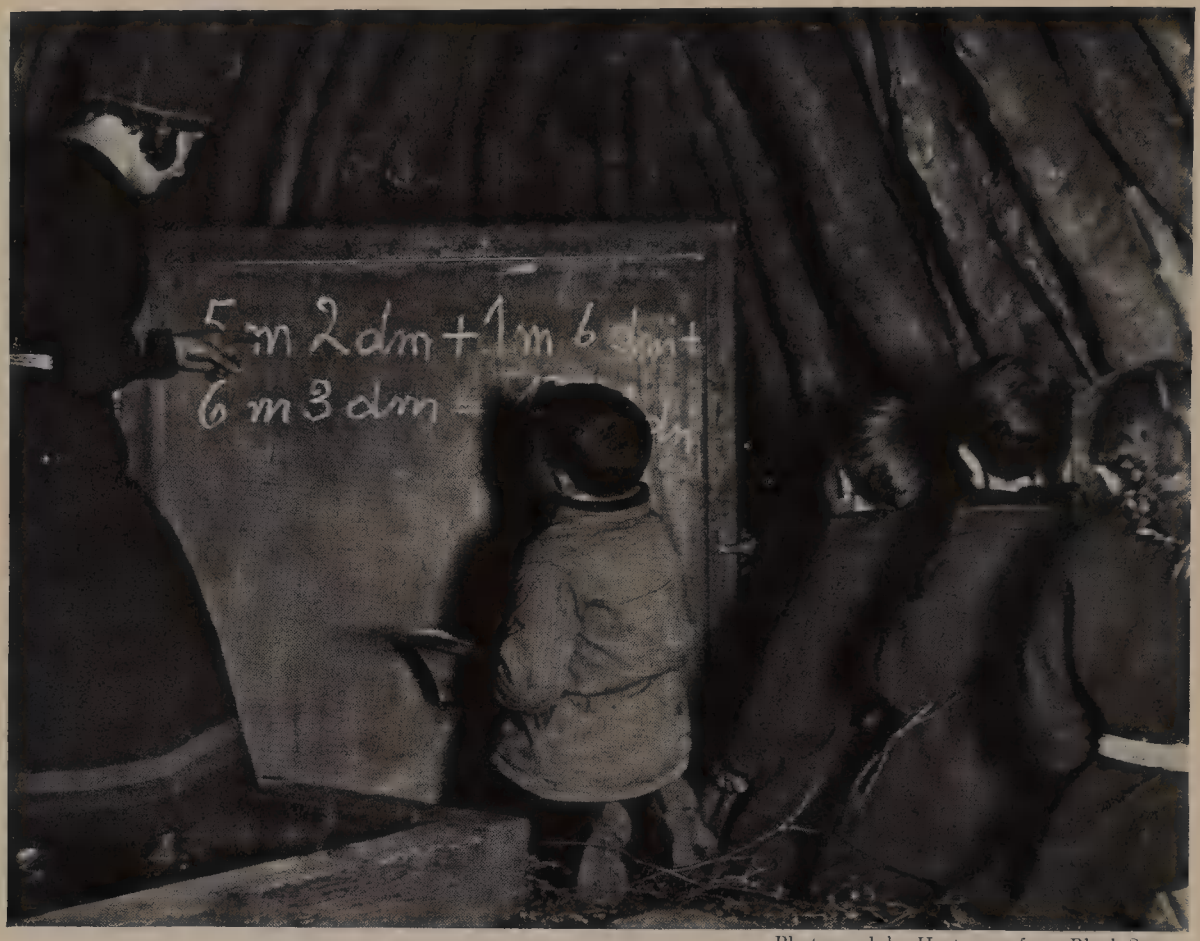
I inferred that this was perhaps the first drawing made by a royal visitor on the blackboard in a Lapp schoolhouse, so I photographed it and later sent the teacher prints for his pupils.

NO ATTEMPT TO CHANGE LAPP HABITS

The thing which impressed me most about this school was the sensible boarding department. The Lapp children live, eat, and sleep in permanent kåtas, where they are taught cleanly habits of floor life, to fit them for life in their home kåtas. When they return home, they will not have had their floor culture interfered with; they will not have to readjust themselves.

It was my privilege to visit Linnés Hammarby, located near Uppsala. This was the last summer home of the most widely known botanist who ever lived, a shrine for all naturalists (pages 667, 668).

In 1732, the year in which George Washington was born, Linnaeus made a journey through Lapland which he described in his



Photograph by Hartmann from Black Star

A LAPP BOY LEARNS HIS METERS AND DECIMETERS

Pupils and blackboard are on the floor, for nomad Lapps do not use tables and chairs. Reckoning distance is important to these wanderers. Geography is a favorite subject (page 674).

fascinating diary, *The Lachesis Lapponica,* copiously illustrated with his own pen drawings. Here the "Father of Botany" collected Arctic plants, including his favorite, *Linnaea borealis,* or twinflower.

He also brought back a Lapp magic drum, now in the National Historical Museum in Stockholm (pages 654-5). The Lapp used this drum to foretell the future and to answer such questions as where lost reindeer were to be found, and whether sick friends or relatives would recover.

When the Lapps were Christianized, they were taught that the use of the magic drum was sinful, and they were persuaded—even compelled—to destroy their drums. This they did so thoroughly that the drums are now extremely scarce even in museums.

At Mount Njunjes we visited a self-educated Lapp family, three of whom were naturalists. They had received their training in natural history from a German scientist, who for a long time had collected in this vicinity. They knew the Latin scientific names of the wild flowers, the birds, and the butterflies. (I tested them on the first two.) From two of these brothers I obtained for the American Museum of Natural History a few butterflies which they had collected and carefully labeled.

We wonder why the Lapps stay so far north where living conditions are necessarily difficult; but they seem contented and seldom leave their native heath.

After I had seen a small Lapp man carry my heavy motion-picture camera for fifteen hours one day in the rain, and after I had tramped twenty-five or thirty miles with Magnus Holmbom, the Lapp ski runner, I was ready to take off my hat to their grit and endurance.

I have observed no more temperate and peaceable people than the Lapps. It is certainly true that they have been unprogressive in many ways. They live in tents, as their ancestors have lived for hundreds, if not thousands of years. Who will say that the tenacity with which they have held to the culture of their forebears has been a disadvantage?

HISTORIC DANZIG: LAST OF THE CITY-STATES

By William and Alicelia Franklin

"CRISIS or no crisis, we must see Danzig!" With this firm resolve calming our political jitters we boarded the Corridor Express in the eventful summer of 1939 for a plunge into the troubled area of the Free City of Danzig, last survivor of a long line of city-states.

From Athens and Venice to Bremen and Riga, every independent secular city of the past had long since struck its colors before the rising tide of modern states. Except Vatican City, Danzig alone, until September 1, 1939, when it was made a part of the German Reich, still flew its own flag, issued its own money, and made its own laws. Danzig was a living relic of bygone days, and we were determined not to let this historical oddity slip through our fingers.

Across our path lay the Polish Corridor (Pomorze), that 130-mile-long wedge of territory from Thorn (Toruń) to the Baltic which severed East Prussia from the rest of Germany and thereby furnished Poland with a direct approach to her narrow bay window on the Baltic Sea.

For some years after the World War a trip across the Polish Corridor had to be made in locked coaches with the shades drawn, but we found the process surprisingly painless. Behind the barbed-wire frontier at Konitz (Chojnice) our German train ground to a halt, and after substituting a Polish locomotive we again sped on our way, through deep pine forests and rolling hills of rye to the flood plains of the Vistula River and the towering battlements of the Marienburg (page 684).

CRUSADERS' CASTLE—WITH CENTRAL HEATING

The mighty Marienburg (Castle of Mary) is the key to Danzig, past and present. Standing on the very frontier of East Prussia, the fortress dominates the area where according to the Treaty of Versailles the boundaries of Poland, Germany, and Danzig met.* In earlier centuries the significance of the Marienburg for Danzig was even greater, for from this stronghold Danzig received its first military protection as well as its earliest and most characteristic architecture, a form of early Gothic in rough, red brick.

One is surprised to learn that the builders of the Marienburg were none of the usual feudal barons who adorned the medieval landscape, but rather the religious Order of the Teutonic Knights. These were Crusaders, who, after returning from the Near East, turned their energies to colonizing and Christianizing the pagan lands of the southern Baltic regions.

Touring the castle, we were amused to find that the warrior-monks had imported many a Byzantine touch, and, practical-minded, had constructed central heating shafts leading from the basement to all major quarters. Although our guide didn't mention it, we were convinced that here was to be found the real reason for the long waiting list of candidates which the Teutonic Brotherhood boasted of in the otherwise chilly 13th century!

At Marienburg we boarded an antiquated "local" for an hour's ride through one of the world's smallest states. Although the territory of Danzig was only three-fifths the size of Rhode Island, yet the Free City had all the paraphernalia of the giant nations of the 20th century, including its own customs inspectors, looking most imposing with their brass buttons flashing the official seal of their tiny state.

Our particular official bowed stiffly and asked for our baggage. When I indicated all six weighty suitcases, he stared in amazement, glanced furtively in the direction of Mrs. Franklin, and with a sigh of understanding stamped our luggage, sight unseen.

As we rattled along over the lowlands of the Vistula Delta, we thought of the checkered history which had produced this pygmy state—area, 754 square miles; population, 407,000.

A FREE CITY FOR FIVE CENTURIES

Although the boundaries of Danzig were designed in 1919 primarily to give Poland a Baltic harbor, still the idea of a Free City of Danzig was more a resurrection of the medieval past than a pure invention of the postwar years. For approximately five centuries in its early history Danzig had actually been a free and independent city. In spite of its various connections with the Teutonic Order, the Hanseatic League, and the Polish kings, Danzig had always been

* See "Flying Around the Baltic," the National Geographic Magazine, June, 1938; and the new map of Central Europe and the Mediterranean, sent to members as a special supplement to The Magazine for October, 1939.

Photograph courtesy Danzig Archives

A CITIZEN TAKES THE OATH

This 18th-century print shows a good solid burgher taking the Oath of Citizenship in full regalia. As in other medieval city-states, citizenship was limited to a select few who could pass strict qualifications as to health, wealth, character, and parentage.

able to maintain the authority of its city council of merchant princes.

But long-continued conflicts between Poland and Sweden so weakened the position of Danzig that in 1793 it was annexed to Prussia. From that time Danzig became an integral part of Germany, although Napoleon gave the city an enforced "freedom" of seven years from his Prussian enemy.

At this point our historical ponderings were interrupted by a squeal from our little locomotive, which wished thereby to indicate that we had reached the railway terminal of that freak of history, the Third Free City of Danzig.

ZONING FOR THE PAST

Danzig has a surprising way of impressing the visitor's first glance. Although the city is about as large as Memphis, Tennessee, we found that even the busy railroad station had been built to harmonize with the prevailing architecture of old Danzig. Only the taxis marred the medieval effect of clock tower and rose window. By careful zoning and traditional good taste, Danzig merges imperceptibly into its past. Everywhere we went, even in the major business quarters, we found long rows of magnificent baroque façades with "A. D. 1938" matching the delicate scrolls of her 1638 neighbor.

Quaint old street names also had been religiously preserved. For example, one of our pleasant rambles through the heart of the city took us from "Holy Ghost Street" through "Cow Lane" and "Parson Lane" to "Bread Counter Street." From there we turned into "Old Horse Lane" and walked down "Thread Lane" and "Street of Nine Eyes" as far as the avenue called "Pepper City."

Strolling through the city, one begins to wonder whether the old Danzigers were

Photograph by Waro © C. Anders & Co.

GERMANY HAS ANNEXED DANZIG, WHOSE TROOPS NOW MARCH FOR THE REICH

Soldiers of one of the city's Nazi military groups parade past the railroad station. Of the 407,000 population of the former Danzig state, about 93 per cent are German. The latest shift of sovereignty is the tenth in 800 years. From 1920 until September 1, 1939, the city and its environs constituted a free state, governed by its own constitution under the League of Nations, but in customs union with Poland.

Photograph by Rene Zuber © C. Anders & Co.

TRAFFIC BETWEEN DANZIG AND POLAND STOPPED AT THE BORDER FOR CUSTOMS INSPECTION

The sign, photographed before the invasion by German forces in September, reads: "Republic of Poland, Border Crossing, Orłowo-Kolibki." No visa was required for passage across this boundary. The truck was carrying freight between Gdynia, Poland's port, and Warsaw, its capital.

extraordinarily religious, or simply reluctant about walking. At any rate, every tiny section of the old city was supplied with at least one ample church, even in pre-Reformation days. Today the array of religious buildings, ranging from Romanesque to Renaissance, and from Catholic to Mennonite, is truly astonishing.

Mightiest of all is the Church of St. Mary (Marienkirche), begun by the Teutonic Knights in the 14th century. Subsequent burgomasters, with an eye for comfort if not beauty, have since dotted the imposing nave with their own special pews, cosily heated with enormous Dutch ovens. But the original windows still leap toward heaven, to lose themselves in groined arches so ingeniously constructed of handmade brick that modern bricklayers can scarcely be found to attempt a job of reconstruction (page 682).

"At least," as a local architect told us, "no contractors of today would give a five-century guarantee!" Artistically considered, the old glass is a disappointment, but one might reserve a quiet smile for the old windows donated by the medieval guilds who saw nothing inappropriate in gently advertising their homely products alongside the Holy Apostles.

Together with a Danzig friend of ours, we panted up the massive, winding steps to

© Hilde Brinckmann-Schröder

DANZIG DAMSELS ON EXCURSION TAKE A THOUGHTFUL VIEW OF THINGS

Jumpers and blouses are of traditional style. Dresses seen on the streets are either quite modern or simple adaptations of the older designs. Genuine native dress is rarely seen.

the dizzy heights of St. Mary's tower. On the way, we stopped to catch our breath and inspect the vertical wooden treadmill where one strong man, like a squirrel in a cage, could toll the heavy bells. At last we reached the summit, atop 248 feet of ancient brick rising sheer from the cobblestone street far below.

THREE-WINDOW MILLIONAIRES

A breath-taking view was the reward of our breath-taking climb; for our horizon lay beyond the Baltic Sea, and at our feet clustered the last of the city-states, with its pointed fortifications and circular streets looking for all the world like a 15th-century engraving. Taking advantage of the panorama, our Danzig friend pointed out some of the striking characteristics of the old town.

"As you can readily see," began our oracle-friend, "all the old Danzig houses are very narrow in front, but run a long way back from the street. Most of them have only two windows in front, but a few of the most elaborate ones have three. Those houses belonged to the millionaires—the 'three-window men'—who could afford the higher taxation which they had to pay for the luxury of an extra window. Those were the so-called patrician houses of the Uphagens and Steffens (pages 685, 692).

"Space was always at a premium within the old city gates," continued our friend, "but the good burghers were not to be denied their flower gardens; so special

Photograph from William Franklin

HIGH ABOVE NARROW, TIGHT-PACKED DANZIG HOUSES LOOMS THE MAGNIFICENT BRICK PILE OF THE CHURCH OF ST. MARY

Photograph by Rene Zuber © C. Anders & Co.

DANZIG BOYS FACE THE FUTURE WITH A GRIN

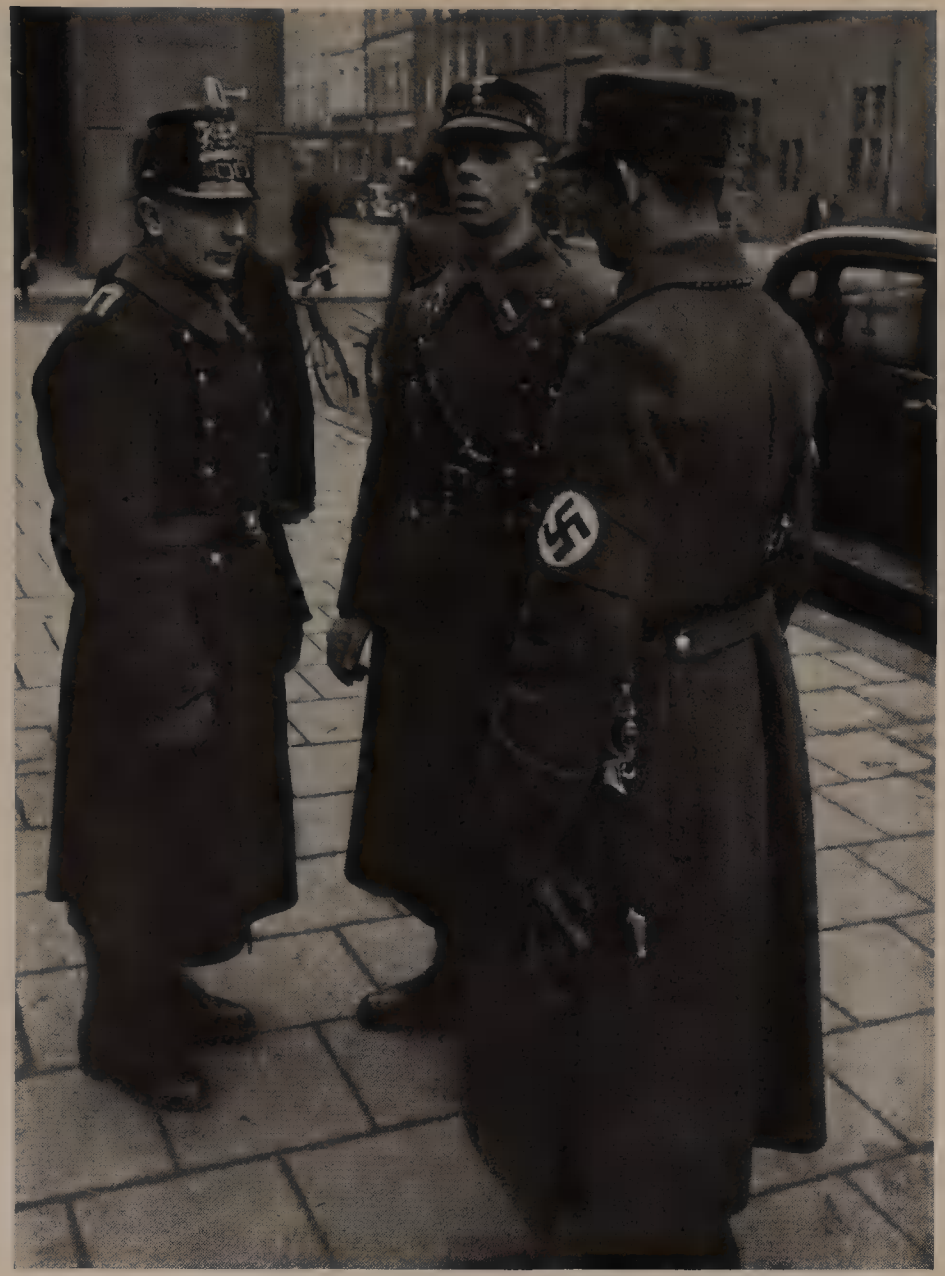
Photograph by Paul Wolff from European

NO CHARGE FOR LOOKING

Photograph courtesy Ferd. Preuss

MIGHTY MARIENBURG WAS A STRONGHOLD OF THE TEUTONIC KNIGHTS, MEDIEVAL CONQUERORS OF PRUSSIA

This picture of the famous church and castle was made from the Danzig bank of the Nogat River, which separated the Free City from East Prussia. From 1309 to 1457 the fortress was the seat of the Grand Master of the Teutonic Order. At the battle of Tannenberg (1410), the Poles crushed this military brotherhood (page 677).



Photograph by Waro © C. Anders & Co.

NAZI STORM TROOPERS CHAT WITH A POLICEMAN

A high-crowned cap with large metal insignia distinguished the Danzig "cop."

Photograph from William Franklin

A TASTE OF FLANDERS IN DANZIG—THE STEFFENS HOUSE

Heavy taxes were imposed on houses with three windows across the front (p. 681).

Photograph by Pasi from Three Lions

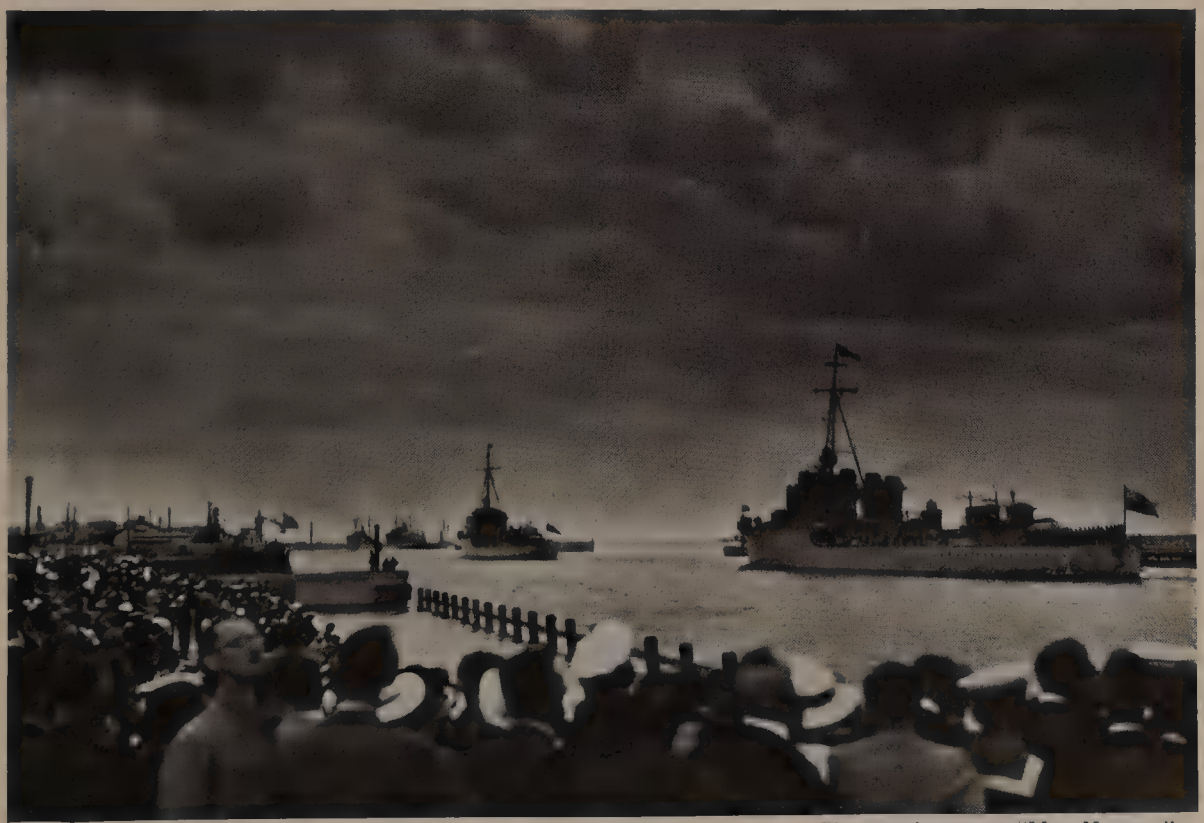
GOLD BRAIDS AND WHITE BLOUSES GLEAM AGAINST AN AGE-OLD PORTAL OF DANZIG'S SPLENDID CITY HALL

A class of school girls has come out on the balcony to view the venerable coat of arms with its lions.

Photograph by William Franklin

DOWN THE WAYS OF SCHICHAU YARDS SLIDE SOME OF EUROPE'S FINEST SHIPS

Before the World War, this shipbuilding plant turned out a number of Germany's big naval vessels.



Photograph courtesy "Mare Nostrum"

POLES CROWDED GDYNIA'S NAVAL BASE TO WATCH THEIR FLEET IN REVIEW

At the outbreak of hostilities, a few destroyers and submarines comprised the backbone of Poland's fighting fleet. Its base was here in the harbor of the busy Baltic port. Three Polish destroyers joined the British Fleet.

Photograph by William Franklin

WHEAT FLOWS FROM OLD-TIME GRANARIES INTO A MODERN STEEL SHIP

Wooden vessels formerly moored before Danzig's 18th-century timber-and-stucco warehouses and elevators. Then, as now, cargoes were chiefly coal, grains, timber, and wood products.

Photograph by Maynard Owen Williams

DANZIG'S CRANE TOWER IS THE HARBOR'S CHIEF LANDMARK

For six centuries ships have discharged or loaded cargoes within its shadow. Two big treadmills furnished power for the hoisting machinery. Once the tower was used to drag a wrecked motorcar out of the Mottlau River.

areas were set aside just outside the city walls, where each good family could enjoy its own little plot and sit and gossip of a warm summer evening. The Long Garden and New Garden Streets still mark the sites of these old flower beds."

Little did we suspect that at the old City Hall (pages 686, 694) we would see one of the world's most expensive paintings. Of course, we had expected that the council rooms would be as magnificent as they proved to be, in the ornate style of the High Renaissance and in keeping with the dignity of the wealthy patricians whom even the crowned heads of Europe addressed as "Most noble and dearest friends." But thinking of the fabulous art treasures in many a world-famous gallery, we remained very skeptical about the value of Danzig's alleged prize.

Our guide was positive. "Come this way," he said, "and I'll show you the world's most expensive picture!" With our curiosity now thoroughly aroused, we followed him into a small antechamber where hung a not very distinctive portrait of Napoleon I.

"That's it," he pointed. "You see, Danzig had no choice in the matter. To avoid being wiped out by Napoleon's armies, it was forced to buy this portrait of the Emperor from a French general. The picture alone cost 80,000 gold ducats and the remainder of the tribute totaled almost 40 million marks; so that was certainly the world's most expensive picture!"

Photograph by William Franklin

FOR THREE CENTURIES THE SALMON HAS MARKED THE HOME OF DANZIG'S FAMOUS DISTILLERY

Here is produced "Goldwasser" (goldwater), a strong, sweet liqueur with bits of gold leaf floating in it.

In the famous Guild Hall, or Artushof (p. 694), we found another painting with as curious a history as one could well imagine. After first showing us the splendid collection of guild trophies, our guide stopped in front of a mural and told us this story:

"A Danzig artist by the name of Anton Möller was hired by the guilds to decorate this panel in 1602, with the plans calling for an allegorical Last Judgment scene. But

© C. Anders & Co.

THROUGH THE GREEN GATE TRAFFIC REACHES THE HEART OF DANZIG

A streetcar and pedestrians cross the Green Bridge over the Mottlau River. Jealously Danzig clings to its medieval character, building new baroque façades to harmonize with old structures (page 678). In the center background loom the tall tower and spires of the Church of St. Mary (page 682); at the right rise steep gables of the English House, the city's finest Renaissance dwelling.

Photograph by Soennke

OPERA IN THE WOODS—A SCENE FROM "LOHENGRIN"

Justly famed is Zoppot's "Forest Opera," of which the natural setting deep in a forest glade is ideal for presentations of Wagner (page 696).

Photograph by Reinke

EVEN BASEMENT DOORS BEAR EXQUISITE CARVINGS

Danzig's architecture is noted for its wealth of ornamental detail. Merchant princes employed Europe's best artists and craftsmen to decorate their houses, churches, and public buildings.

Photograph by William Franklin

"IN HARMONY SMALL STATES GROW AND IN DISCORD GREAT ONES FALL"

So reads the inscription over Langgasser Tor, through which Danzig troops are riding.

Photograph by Berthold M. Hemme

PRICELESS TREASURES OF ART ARE DISPLAYED IN THE DIELE OF DANZIG

The house is preserved as a fine example of the richly furnished old homes of the patrician merchants.

Photograph from William Franklin

A SHIP APPROACHES ZOPPOT, THE REGION'S MONTE CARLO

Beyond the pier jutting into the Baltic Sea lie the beach and Casino of Danzig's second largest city.

Photograph by Pasi from Three Lions

POLISH POST BOXES WERE INSTALLED IN THE FREE STATE

On the card beneath the eagle was printed in Polish and German: "Only for letters to Poland."

Photograph by Waro © C. Anders & Co.

DANZIG BOASTED THIS SKYSCRAPER WHEN MANHATTAN WAS BOUGHT FROM THE INDIANS

The City Hall's slender spire with its chimes has towered above Long Market for 380 years. Through this square have tramped the armies of many nations during Danzig's turbulent history. When Adolf Hitler welcomed Danzig into the German Reich on September 19, 1939, he spoke to Nazi throngs in this plaza from the 15th-century Artushof, or Guild Hall (building above the wagon).

the artist had recently been jilted by the burgomaster's daughter and he consequently got his revenge by painting her as the central figure being carried off to the eternal fires.

"The resemblance was unmistakable and the old burgomaster in a spluttering rage informed the artist that he would have to cover the features of his central figure. Whereupon Möller returned to his work and painted the transparent glass globe which you see around the lady's head, just below the cross which he mercifully added.

"When the city council wrathfully sent him back to change his vengeful masterpiece a second time, the incorrigible artist painted the faces of the city councilors on the sorrowing inhabitants of his snake-infested Purgatory."

Just what then happened to the lover-artist we couldn't find out; though the worthy councilors must have had an unsuspected sense of humor to permit the mural to stay as it was.

© Douglas Chandler

A WROUGHT-IRON EAGLE DECORATES THE CITY HALL

Photograph courtesy Danzig Archives

DANZIG'S OLDEST SEAL—USED IN 1299

LAND BELOW THE SEA

One shouldn't forget that Danzig, the city, was by no means all of Danzig, the state, though the terminology is often confusing. The remainder of the area lay in almost equal halves to east and west of the muddy

Vistula as it rolled north from Poland to the Baltic Sea.

Our first excursion was into the eastern part of the state which bordered on the broad, shallow lagoon called the Frisches Haff.* Strikingly Dutch is the appearance of this flat farming area, most of which lies from two to five feet below the level of the near-by sea. Many of the early settlers were in fact Flemish, and even the Teutonic Knights adopted the Dutch types of dikes and windmills for controlling the unruly Vistula and protecting the low-lying plains.

We were surprised to find that Danzig had not a single bridge over this elevated river which divided the state. Since the only suitable spot for a bridge lay under Polish control at Tczew (Dirschau), 20 miles up the river, the citizen of Danzig had to use one of the three primitive ferries which joined the lifelines of road and railway in his little state.

But far from primitive is the system of flood control along the Vistula. Ever since the 14th century the restless stream has felt the hand of man, with the result that today almost two-thirds of the area which formed the Danzig state owes its existence solely to the man-made levees.

Like the Netherlands' Zuider Zee, the great lagoon of the Frisches Haff has also been forced to beat a steady retreat before the land reclamation projects of the ambitious Danzigers.

SOPHISTICATED ZOPPOT

We returned from our little junket to the sub-sea villages of the Vistula Delta with the impression that the Danzig state was as quaintly primitive a farming area as we had ever visited. But our impression was only half correct, for in the western part we found one of Europe's most sophisticated cities. Zoppot, the state's second largest city, boasted a bathing beach, one of the best on the Baltic, a gambling Casino, which sought to rival Monte Carlo, and an open-air opera (page 693).

Better judgment dictated that we should not tarry too long in the palatial Casino with its glittering wheels and laughing crowds. In such an atmosphere immunity vanishes like ice in August and the spreading contagion paralyzes the arithmetic sense. Feeling already slightly under the influence, we fled to the safer ground of grand opera.

Deep in the wooded hills outside of Zoppot we saw a performance of Wagner's *Tannhäuser* which for beauty of setting could hardly be equaled. The curtain of living green with castle turrets against a background of primeval forest would certainly have delighted the romantic heart of the great master of the music drama (page 691).

HARBORS OLD AND NEW

To complete our tour of the Free City with a taste of its ancient harbor, we decided to leave by boat.

Boarding our little vessel at the wharf near Speicher Insel, "Granary Island," we watched the modern freighters loading cargoes from 18th-century warehouses. Down the canal-like Mottlau River we sailed, past the picturesque Crane † and the infinitely mightier cranes of the newer shipbuilding yards (page 687). At the piers in the so-called "Dead Vistula," ‡ we saw ships from literally all the Seven Seas, for Danzig was still an important export center for coal, timber, and grains.

At the very tip of the deeply indented harbor we saw the last remnant of Danzig's Hansa days: the fort that guarded the heavy-laden galleons which were once the Free City's pride.

As the spires and towers of old Danzig faded into the twilight, we entered a new port and a new world. The new port was Polish Gdynia, captured shortly afterward by the Germans, and the new world was the 20th century whose engineering had enabled Gdynia in its short life of thirteen years to outstrip in commercial importance the last of the city-states, historic Danzig.

* The Haff (*i. e.*, lagoon), lying between Danzig and Königsberg, is 52 miles long, 4 to 12 miles wide, and 310 square miles in extent. A narrow spit, with a navigable channel, separates it from the Baltic. Several rivers flow into the Frisches Haff, so named from one of them, the Frisching.

† See "War Clouds over Danzig and Poland's Port," NATIONAL GEOGRAPHIC MAGAZINE, October, 1939.

‡ The local term for the distributary branches of the Vistula. They have practically no current.

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VOL. LXXVI, No. 6 WASHINGTON DECEMBER, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

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PUERTO RICO: WATCHDOG OF THE CARIBBEAN

Venerable Domain Under American Flag Has New Role as West Indian Stronghold and Sentinel of the Panama Canal

By E. John Long

FAR below the Clipper plane, swiftly winging me from Miami to San Juan, the broad expanse of Mona Passage was streaked with the white wakes of lumbering freighters. I was crossing one of the world's busiest trade tracks—the ocean highway from northern Europe to the Panama Canal.

It was difficult to believe that in these luminous blue waters Spaniard and Englishman, Dutchman and Frenchman, buccaneer and merchantman, galleon and caravel, frigate and brigantine for centuries struggled and maneuvered for mastery. It seemed even more incredible that the peaceful parade of commerce was threatened again.

Co-pilot George King came back to my seat and pointed out the window.

"Look ahead," he said. "Do you see that high rocky cliff, rimmed with white breakers?

"We're approaching Point Borinquen, northwest corner of Puerto Rico. As we fly over it, notice the wide, nearly level tableland back from the cliffs. That's the site of the new Army Air Base, the 'big gun' in the scheme of national defense along the Atlantic seaboard."

I could see nothing but palms, a few patches of sugar cane and a winding country road. It did not look like a promising place for an airport and I said so.

Co-pilot King went forward and returned in a minute with a large map of the West Indies and Central America, which he spread in my lap. He drew lines from Point Borinquen to Miami, the Panama Canal, Trinidad, Caracas, and ran one off the map in the direction of Bermuda.

THE ISLAND'S STRATEGIC LOCATION

"Now do you see? About 1,000 miles to the Panama Canal, 1,000 miles to Miami, 700 to Bermuda, 550 to Caracas on the mainland of South America, 650 to Trinidad. This is the hub of a wheel.* Put enough planes here, and enough land forces to guard your bases, and Puerto Rico becomes the 'Gibraltar of the West Indies,' or the 'Hawaii of the Atlantic.'"

Less than a month later, I saw the first U. S. Army plane land on an improvised field swiftly cleared from the cane fields atop that mesa, and the harbor of San Juan fill with Navy planes, tenders, and gray ships of war taking up their duties as part of the President's neutrality patrol.

After four centuries the land whence Ponce de León sailed to discover Florida is again an outpost—this time facing east! Ancient sentry boxes on its huge Spanish fortifications (Color Plate II) are symbols of the new watch on the Caribbean. Symbols but not models. Today man digs

* See map supplement "Mexico, Central America, and the West Indies," with this issue.

Photograph by E. John Long

PUERTO RICO'S 16TH AMERICAN GOVERNOR TAKES THE SALUTE IN FRONT OF THE CAPITOL

At the left of Admiral William D. Leahy, watching the Inaugural Parade, September 11, 1939, stands Acting Governor José E. Colom. Señor Colom's father was one of the first to receive American troops arriving in Ponce in 1898. When he and other Spanish officials were told they must evacuate Ponce within 48 hours, his father replied that 48 minutes would be sufficient! Overhead hangs the seal of Puerto Rico, granted by King Ferdinand of Spain in 1511.

underground, or levels hills and fills swamps to make airports that can send "flying fortresses" far over the horizon.

We flew eastward that clear August morning above the fertile plain which rims Puerto Rico's rocky north coast. Green and brown fields stretched up to cone-shaped foothills. Beyond reared dark mountains, their heads swathed in clouds.

Warm sunshine poured down on sugar and pineapple fields, orchards and palm groves, silver rivers, and little towns whose houses crowd together as if they fear to steal space from precious crops. From the air Puerto Rico obviously is one of the earth's most densely populated places.

It had been nearly 15 years since my last visit to San Juan, and I was prepared for changes. Even the name of the island was different, the Spanish *Puerto Rico* having been restored in place of the American adaptation, *Porto Rico*.

A NEW NAVAL AIR BASE

Expecting change, I was nevertheless surprised to see a New Yorkish skyline of tall buildings behind the grim battlements of El Morro and the Fortaleza, which were old when the Pilgrims landed. And everywhere were scaffolds, girders, and derricks for more buildings under construction.

Our plane docked at the trim Pan American air base on Isla Grande. No longer an island, this point of land is part of an enormous area built up from silt dredged from San Juan Harbor. Extending back to the suburbs of Miramar and Santurce, it will soon be covered with long runways, hangars, and barracks. This is the site of a $9,000,000 U. S. Naval Air Base (p. 700).

Photograph from Wide World

ALL SAN JUAN LOOKS UP AS MARINE PLANES ROAR OVERHEAD

A squadron based at Culebra, east of Puerto Rico, circled over the old Spanish fortifications of the Capital during fleet maneuvers last winter. The wide expanse is El Morro's extensive parade.

Photograph by Edwin L. Wisherd

MISSION AND MODERN STYLES BLEND IN SANTURCE

The building boom in San Juan's suburbs has brought many contrasts between Spanish Mission type homes (left) and modernistic apartment houses (right). Areas near the capital that only a few years ago were covered with grass and weeds are now residential districts (page 709).

Photograph by Ralph Kestly

TENTS FOR THE "WATCHDOGS" OF THE CARIBBEAN MARK THE START OF A NEW NAVAL AIR BASE AT SAN JUAN

Old Spanish fortifications and a modern American skyline look down on the Isla Grande headquarters of the Neutrality Patrol. Seven of the twelve flying boats assigned to Puerto Rico are drawn up back of the hangar. Daily they patrol the Caribbean area. Across the harbor the cruisers *Tuscaloosa* and *San Francisco* are docked.

Photograph by Edwin L. Wisherd

GRAY MEN-OF-WAR AND NAVY PATROL PLANES STAND GUARD IN SAN JUAN'S SPACIOUS HARBOR

Puerto Rico, almost as large as Connecticut, has assumed new national importance as guardian of American interests in the Caribbean. In the foreground (with clock-tower) is the terminus of the American Railroad of Puerto Rico, a 288-mile system that nearly encircles the island. The smoking chimney among the hills to the right belongs to the new government cement plant at Cataño.

Photograph by Edwin L. Wisherd

"AIR RAID PRECAUTIONS" ARE NOTHING NEW IN PUERTO RICO

But here the enemy from the sky is the hurricane, which uproots trees and levels crops (pages 706-7). This stout shelter, near Caguas, has a corrugated iron roof secured with wire and crossed railroad rails. The word "hurricane" is derived from the Carib Indian *huracán,* meaning "big wind."

Ashore in San Juan there were more surprises. Narrow streets teemed with motor cars and busses. Radios blared, red and blue neon signs flashed, newsboys shouted extras in Spanish, and business men, clerks, and stenographers walked briskly.

Spanish is the almost universal language of the island, which is not surprising when one considers that Puerto Rico for nearly 400 years was the "ever-loyal" colony, and the last Spanish possession in the New World. Of the island's 1,800,000 inhabitants, only about 3,000 or 4,000 are English-speaking "continentals."

"Be careful of the term 'American'," I was cautioned. Puerto Ricans, except a few Spanish subjects, have been American citizens since 1917, and so all are properly "Americans." Visitors or residents from the States are called "continentals," although I have heard "Americanos" used for people from the States when Puerto Ricans were talking in Spanish.

In many ways, however, Puerto Rico is a Spanish island and San Juan a Spanish town. As one goes back into the island the Spanish flavor becomes more pronounced, despite the American flags over schoolhouses, and the U. S. mail and army trucks.

The currency, mails, lighthouse service, customs, and coast guard are the same as those of continental United States, yet Puerto Rico under the Organic Act of 1917 elects its own legislature, makes its own laws, and keeps all revenues collected on the island.

POLITICS IN EXPLOSIVE SPANISH

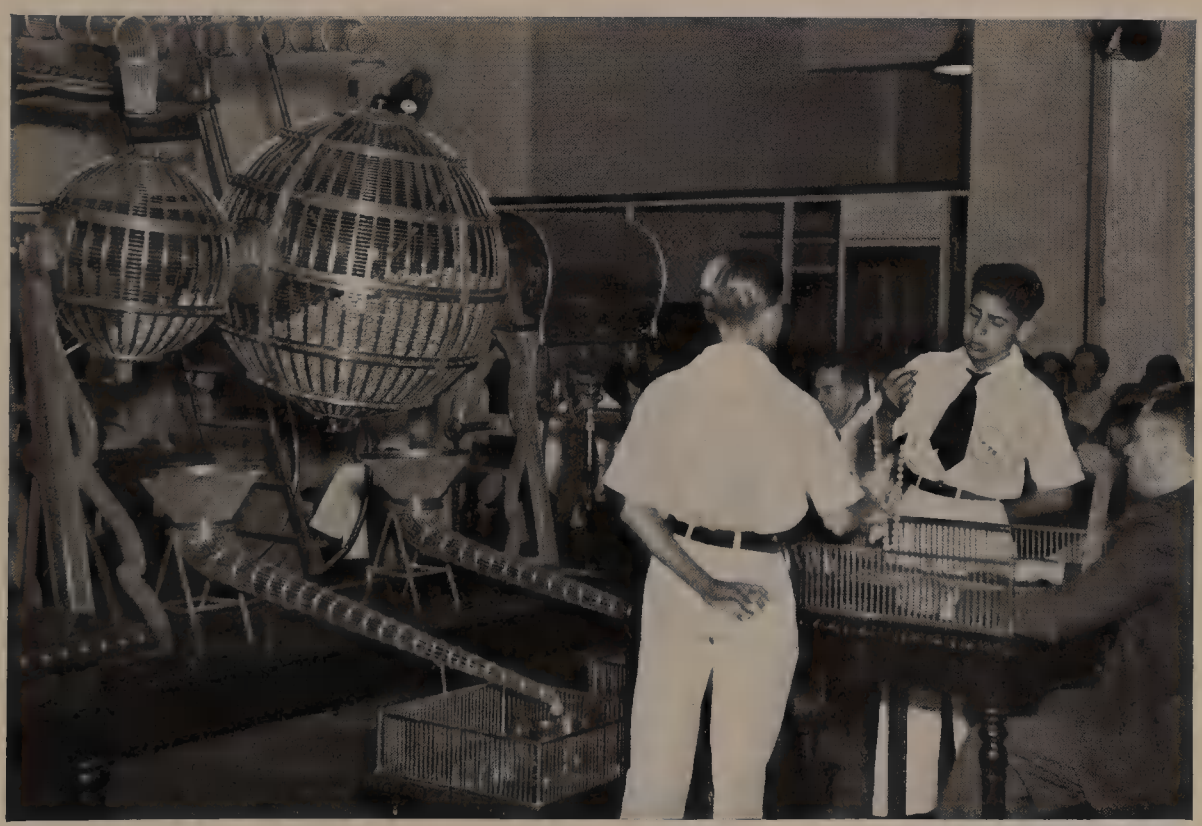
I strolled along the downtown streets of the old walled city, peering into sunlit patios and busy cafés, like those of Habana, where politics is discussed in explosive Spanish over cups of strong black Puerto Rican coffee. In front of a modern air-conditioned department store, the *chicharrón* peddler still shouts his wares—cracklings, or roast pigskin, golden brown and delicious. Lottery ticket venders block the walk, for here lotteries and cockfighting, as well as betting on horse races, are legal (opposite page).

For a few cents a sidewalk vender will peel an orange for you with a knife so

Photograph by E. John Long

LITTLE REMAINS OF CAPARRA, PUERTO RICO'S FIRST TOWN

Two fair visitors examine some bits of pottery and glazed Spanish tile from the ruins of the home of Ponce de León, first Governor of the island, discoverer of Florida and seeker of the Fountain of Eternal Youth. Founded in 1509, Caparra was abandoned two years later (page 721).



Photograph by Edwin L. Wisherd

SINCE 1934 LOTTERIES HAVE BEEN LEGAL IN PUERTO RICO

Patterned after the old Spanish lottery, outlawed for 36 years, the drawing takes place before three prominent citizens, acting as honorary witnesses, and the public at large. From the smaller circular cage (left) come the "number balls"; from the other the "prize amount balls." About a third of the receipts is distributed to combat tuberculosis, relieve the destitute, and equip hospitals.

Photograph by Edwin L. Wisherd

A FINNISH TRAINING SHIP FRAMES A VISTA OF SAN JUAN HARBOR

One of the busiest ports in the West Indies, the Puerto Rican capital welcomes cruise steamers, men-of-war, freighters, and humble fishing craft. Clipper planes, carrying passengers and air mail, link San Juan with Florida, South America, and neighboring islands. The three-masted schooner above has come from the Dominican Republic, on the near-by island of Hispaniola, with a load of charcoal. San Juan has modern electrical and gas services, but much cooking is still done over small charcoal braziers.

sharp that the peeling reaches in one long strip unbroken to the ground. Boys with land crabs strung together and hung about their necks, nuns in black robes, sailors from foreign ships in the harbor, visitors loaded down with string rugs (Plate XII) and needlework, shy mountain folk carrying baskets of fruit on their heads—all these and more make up the pageant of movement and color that streams through the old walled city.

With a population of 140,000 people, most of whom live in the suburbs, San Juan has a commuting problem as perplexing as that of mainland cities. Gone are the rickety busses of a few years back—the *guaguas* with entrances in the rear and such picturesque names as "In God We Trust" and "La Coqueta." They have been replaced by a modern bus system which collects 75,000 fares a day on its six major routes. Many who work downtown go home for a leisurely luncheon, so San Juan has four instead of two "rush hours."

I went down to the docks to see at first hand what Puerto Rico needs and sells. Into the holds of steamers, most of them American, poured sugar, alcohol, molasses, rum, coffee, tobacco, fruit, needlework and lingerie, coconuts, buttons and basketware —the principal exports. From other ships, also American, came rice, meat, beans, codfish, flour, lumber, shoes, cotton and silk goods, fertilizers, gasoline, and scores of manufactured articles—the chief imports.

Puerto Rico ranks eighth among world customers of farmers and business men of continental United States, and second in Latin America.

SOME HISTORIC LANDMARKS

San Juan, second in age only to Santo Domingo (Ciudad Trujillo) among New World capitals, has a wealth of historic places. In its venerable cathedral, founded in 1527 and rebuilt in 1802 after an earthquake, rest the ashes of Ponce de León. San José church, built in 1523, is one of the oldest religious edifices in continuous use in America. Casa Blanca, dating from 1523, has been restored as headquarters for the commander of the U. S. Army's new "Puerto Rican Department" (Plate III).

Since 1639, venerable La Fortaleza has been the official residence of the Governors of Puerto Rico. The dungeons and battlements of El Morro and San Cristóbal still excite the admiration of military men. But these have all been vividly described before.* My interest on this visit was in the modern.

Puerta de Tierra, "land gate," they call the once barren eastern end of San Juan Island, beyond the old city walls. Fifteen years ago more than a third of it was rock, brush, and weeds. But what a transformation today!

From the Plaza de Colón, under the shadow of the towering ramparts of San Cristóbal, two fine boulevards reach out toward the suburbs. One of them skirts a cliff along the sea, with vistas of white surf pounding on the rocks and reefs.

The other, the old Carretera, is lined with splendid public and semi-public buildings. I recognized the Casino, the Y. M. C. A. and the Carnegie Library. But the neat lines of the Ateneo (dedicated to Arts, Science, and Literature) and the blue and white tiled Spanish Club are new.

New also is the imposing Capitol building, seat of the Insular Legislature, its marble dome gleaming in the sun (Plate X). The Capitol, and its handsome neighbor, the School of Tropical Medicine, were under construction during my previous visit.

AIR-CONDITIONED OPERATING ROOMS

To the original building of the School of Tropical Medicine, modelled after the Palace of Monterey in Salamanca, a research hospital with air-conditioned operating rooms, a library and auditorium, a service building, physiology and pathology laboratories, a primate house, and an experimental animal house are being added.

As a layman I thought that, with the conquest of typhus fever and Colonel Bailey K. Ashford's discovery that hookworm was the cause of anemia in Puerto Rico, the major health problems of the island had been solved.

"On the contrary, our work is just beginning," Dr. G. W. Bachman, distinguished director of the School told me. "The tropics present many challenging medical frontiers. For instance, there is the dread blood fluke. Never swim in a river in Puerto Rico. Almost all of them are infested with a tiny parasite which enters the skin, reaches the blood stream and finally the intestines, with dire and sometimes fatal results."

* See "Porto Rico, Gate of Riches," by John Oliver La Gorce, NATIONAL GEOGRAPHIC MAGAZINE, December, 1924, and "Skypaths Through Latin America," by Frederick Simpich, January, 1931.

Photograph by E. John Long

ON THE LEPER COLONY GROUNDS GROWS A CHAULMOOGRA TREE

One of the most dramatic expeditions in the history of plant exploration was Dr. Joseph F. Rock's search for the tree whose fruit yields an oil which alleviates dread leprosy. He found it in Burma, in 1921, and in 1926 this specimen was planted near Trujillo Alto by the Forestry Service. It survived the hurricanes of 1928 and 1932 but has never borne fruit. Now 50 patients at the leper colony receive injections of chaulmoogra compounds.

The broad general program of the school is directed toward making the once disease-ridden tropics as safe and healthful as northern climes.

"SOUND MONKEY BUSINESS"

The school can point to many such accomplishments, as well as less dramatic studies of nutrition, parasites, and anemias. This year it undertook 95 projects, in addition to supervision of the work being done at Santiago, the much publicized "monkey island" off the eastern coast of Puerto Rico.

"The Santiago project is what we call 'sound monkey business'," Dr. Bachman explained. "Its purpose is to raise and to sell rhesus monkeys of known ancestry and free from disease. Each year thousands of rhesus monkeys from India are bought by zoos and other scientific institutions, but many die from tuberculosis or from changes in diet. Ours are healthy and acclimated; their diet has been established" (p. 738).

"THE SPIRIT OF 76 DEGREES"

Not far away is the Weather Bureau, in a small building seldom thought of until a hurricane comes roaring up from the south Atlantic. Then reports flash in from ships at sea, neighboring islands, and the mainland. Expert calculations soon chart the storm's course and speed. The insular police and the island's four radio stations warn those in its path.

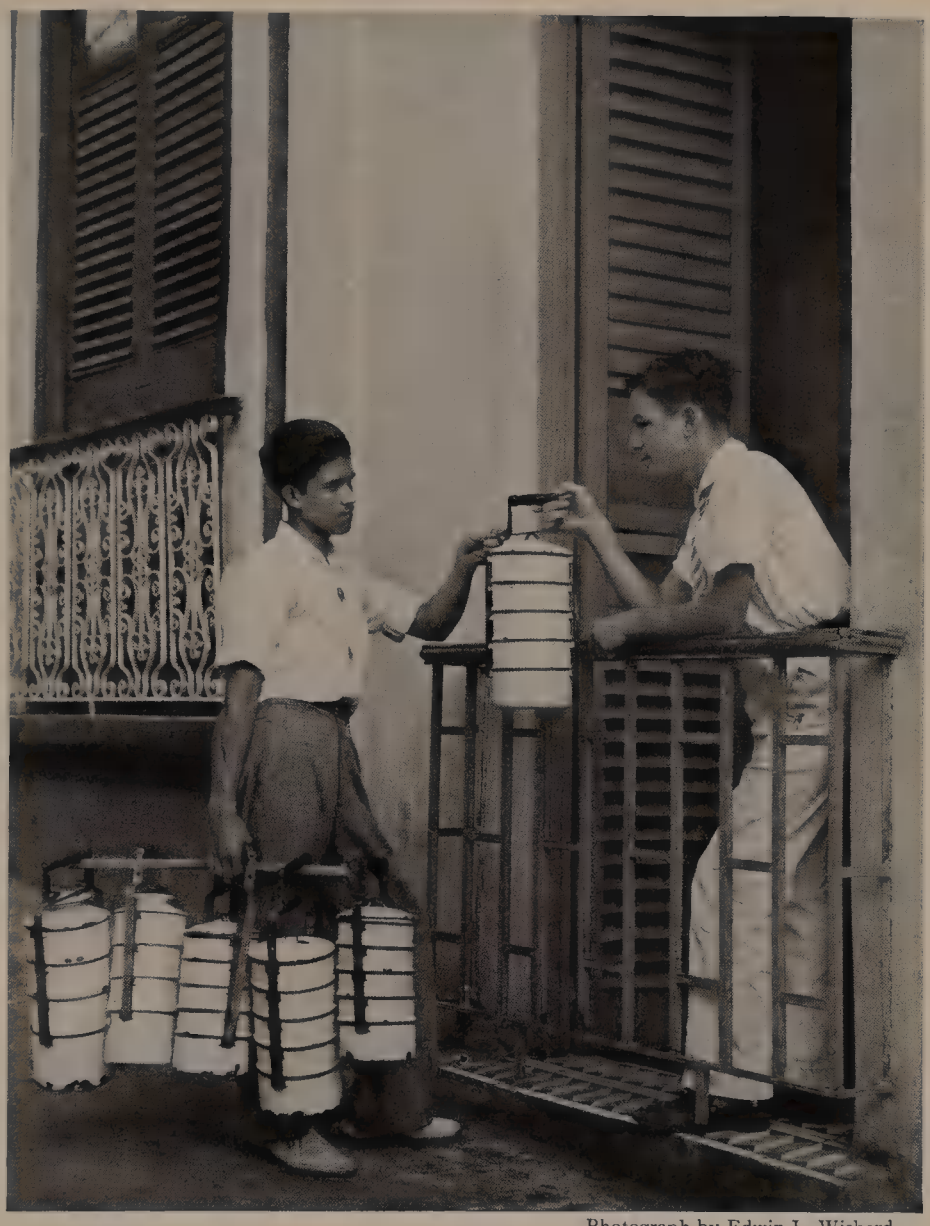
It is a tribute to the accuracy of the Bureau's forecasts that few lives were lost in the last two great hurricanes of 1928 and 1932. In 1928 the Bureau registered 160 miles per hour, and then the anemometer blew away!

Hurricanes, fortunately, have been few. Usually only steady trade winds blow

from the east, and the temperature range is small. It is seldom warmer than 85 in summer and seldom colder than 65 in winter, giving currency to the slogan: "Puerto Rico, The Spirit of 76 Degrees!"

A Puerta de Tierra landmark is the convent of Notre Dame. Here I saw drawnwork, filet embroidery, and other needlework, until recently the second most important source of income in Puerto Rico, being made by girl apprentices under the watchful eyes of patient nuns.

Continuing along the Carretera, past the red towers of the Navy Wireless Station, where formerly only brush and weeds grew, is a beautiful park, stocked with rare native plants and flowers. Opposite it, in a new baseball stadium, the pennant-winning Cincinnati Reds trained a few seasons ago. Puerto Ricans are ardent baseball fans.



Photograph by Edwin L. Wisherd

"CURB SERVICE" FOR A FIVE-DECKER LUNCH

If cook has a day off, or if work at the office prevents going out for lunch, you can have a well-balanced meal delivered in such cans. Rice, beans, fish or meat, fresh vegetables, and a dessert make up a typical menu. Shutters and grille balconies are characteristic of houses in the old walled city of San Juan.

REHABILITATION HEADQUARTERS

The barracks-like buildings nearby belong to the Puerto Rico Reconstruction Administration, familiarly known as PRRA (pronounced "Praw"). PRRA is carrying out the economic rehabilitation program of the Federal Government in Puerto Rico. Its island-wide activities range from reforestation and slum clearance to resettlement of farmers, soil conservation (page 725), cattle tick eradication, malaria control, fruit canning, needlework training, and the construction of new schools, post offices, hospitals, police stations, highways, sewers, waterworks, athletic fields and swimming pools.

Diligently, PRRA seeks new sources of income for sugar workers thrown out of employment by the quota (since lifted) and low sugar prices; for fruit growers whose trees and finances have not recovered from hurricanes and competition in the States; for coffee growers out of work because of the world surplus of coffee; for tobacco

"FIVE-AND-TEN" ON FOUR LEGS VISITS THE BACK COUNTRY

The store comes to the customer in the sparsely settled sections of southwestern Puerto Rico near Boquerón. The dry goods department is on the "port side" of the horse; the notion counter is "one aisle to the right!" Catalogue and order blanks are ready for other needs.

Photographs by Edwin L. Wisherd

THE ENTIRE PIG IS BARBECUED IN PUERTO RICO

A popular native food is roast pork seasoned with a sauce made from pepper, salt, garlic, and *achiote*, a red seed from a Puerto Rican tree. Along the highway between Caguas and Río Piedras one sees stands with whole pigs being turned on bamboo spits over beds of live charcoal.

Photograph by Ralph Kestly

LO! THE POOR FRESHMAN, EVEN IN PUERTO RICO

Opening day at the University, Río Piedras, finds the new class taking its initiation gamely. The University, supported by the insular government, has more than 4,000 students. Beyond rises the Franklin D. Roosevelt Tower, which contains a carillon of 25 bells.

planters who find cigarettes capturing the market for mild cigars; and persons living on poor or marginal land.

Because sugar is so easy to grow and normally brings good cash returns, less than half the food needed on the island is raised there. A shipping strike recently caused the island's reserve food supply to dwindle. Think what might happen were the 1,800,000 inhabitants of this island cut off from the mainland for more than six months!

Hence PRRA's emphasis upon raising food and more food. Much land now considered worthless can be made to produce crops by soil conservation. Fruit that rots on the ground could be canned. Surplus or poor sugar land might raise forage crops for animals that would augment the meat supply.

Within gunshot of tiny Fort Geronimo are four leading hotels, and the Union, Country, and Yacht Clubs. In near-by Miramar, a huge graving dock, the largest in the West Indies, is being built. Five bridges link San Juan Island with the growing suburbs of Santurce, Miramar, and Condado. This section of the capital, with its quiet lagoons, overhanging coconut palms, wide boulevards, and pastel-colored apartments and hotels, recalls parts of Miami Beach, Florida.

BUILDING BOOM IN SUBURBS

Today San Juan's suburbs are sharing a building boom which, on a small scale, matches that of the suburbs of Washington. Most of this activity has been financed with private capital. Old Spanish residents and a few wealthy Puerto Ricans once sent their money to Spain and to other European countries for investment. When the Spanish civil war broke out, they began to put their money into Puerto Rican land and dwellings. The first houses and apartments were quickly rented, and the boom was on.

The boom is being accelerated by the coming of Army and Navy officers and

Photograph by Edwin L. Wisherd

HERE WATER DOES DOUBLE DUTY

Near Guayama rushing mountain streams have been curbed by dams and the flow shot through pipes to hydroelectric plants. The water is then used for irrigating sugar cane fields, with hardly a drop reaching the sea.

their families. Also, it is obvious that the narrow streets of old San Juan and the modern automobile shopper do not mix. No one wants to sacrifice the charm of the walled city by widening streets or destroying architectural landmarks, so merchants and residents are moving out to the wide boulevards of Santurce.

"LITTLE PARIS"—AT STOP 22

Around Stop 22 (the halts of the antiquated streetcar line are still used as addresses) in Santurce, a "Little Paris" has sprung up. In the evenings people gather at gay cafés with sidewalk tables. Sometimes the talk is of politics, a subject that can always find a responsive audience in Puerto Rico, which has three major political parties unrelated to those of the States.

But it is more fun when wandering troubadours with guitars and *maracas* (gourd rattles) stop at your table and offer to play and sing such typical Puerto Rican songs as *Lamento Borincano, Madre Mía, Perfidia, Purísima*, or *Naufragio*.

Most Puerto Rican tunes are plaintive inheritances from Spanish colonial days when music was the only relief from the tragedy of being poor or being heartsick. Livelier and more typical of Puerto Rico are the native *plenas* of the hills. The theme of the *plena* may touch any phase of life—romance, politics, a hurricane, the arrival of a distinguished personage, or even a bank moratorium!

In Santurce I sat in with a typical English class at Central High School. I listened amazed as youngsters, whose forefathers have spoken Spanish for uncounted generations, expertly took involved English sentences apart and put them together again. The teacher was an alert young woman from the States, one of more than 220 continentals who, with some 6,300 Puerto Rican teachers, wage the uphill battle against illiteracy.

Although education represents more than a third of the island budget, and is by far the largest single expenditure, only about half the 600,000 children of school age are receiving any education at all.

This represents no lack of interest or enthusiasm on the part of Puerto Ricans; facilities simply cannot be built fast enough. When Uncle Sam took over Puerto Rico in 1898 there were very few public schools, and 85 per cent of the population was illiterate. Today there are more

Photograph by E. John Long

SACKING SALT TO "BAG" MORE VISITORS FOR PUERTO RICO

A cent a pound tax on all salt used is devoted to the development of island travel. In 1938-39 more than 19,000 persons spent their holidays in Puerto Rico. In the arid southwest, near Boquerón, sea water is pumped into shallow lagoons and evaporated, leaving almost pure salt.

Photograph by Edwin L. Wisherd

AT FIRST GLANCE WATERMELONS SEEM TO GROW ON TREES

So abundant and healthy are the giant papayas at the University of Puerto Rico's Agricultural Substation in Isabela that supports had to be rigged to keep the trees from falling over. The papaya is a favorite breakfast fruit. The juice, fresh or canned, is becoming a popular drink.

than 1,800 schools and illiteracy has been reduced to about 30 per cent.

A short bus ride, along a wide new boulevard, brought me to Río Piedras and the beautiful campus of the University of Puerto Rico. Modelled after our State universities, this growing institution has 4,500 students, of which 750 are enrolled in the College of Agriculture and Mechanic Arts at Mayagüez. Dominating the campus is the new Franklin D. Roosevelt Tower with a carillon of 25 bells (page 709).

"The University of Puerto Rico is 'a door and a bridge between the Americas'," one of the faculty told me. "We have a steadily increasing enrollment from Latin American countries, and many summer session students from the States."

On the campus, too, is forestry headquarters for the island. Here the work of the Insular Forest Service, the Federal Forest Service, and the Forestry Division of the PRRA, is co-ordinated. More than 90,000 acres have already been set aside as forest and recreational areas, chiefly in the mountains. The Caribbean National Forest, both the Luquillo and Toro Negro units, and the Maricao Insular Forest, are outstanding. Puerto Rico is soon to have a Tropical Forestry Research Station.

In addition to the introduction of new species of trees—such as Venezuelan mahogany and teak from Trinidad—forestry headquarters has established many homesteads on government forest areas. Free permits for from 5 to 10 acres of land are given to those who will reforest two acres of non-agricultural forest land for each acre used solely for farming. The system is expected to make each forest unit self-supporting and provide a living for many now on the relief rolls.

Down a palm-shaded lane, outside of Río Piedras, the well-equipped insular Agricultural Experiment Station tests soils and new crops for Puerto Rico.

ALONG A ROAD OF FLOWERING FLAME

Perhaps in the West Indies there are roads as beautiful as those of Puerto Rico in July and August, when the flamboyant or royal poinciana is in bloom. But I have seen nothing to compare with the highway that leads to El Yunque (the Anvil) in the Luquillo unit of Caribbean National Forest. For miles one travels under a canopy of living flame, bordered by even more vivid hibiscus bushes.

At Mameyes the road turns upward. You twist and climb along a highway so crooked that you can see your own car's tail light! But the road is good, and constantly there unfold sweeping views of sea, plain, and foothills. Finally comes the rain forest, with ferns as big as trees (Plate XV), delicate orchids like butterflies hung on the palms, graceful lianas, and all the tangled underbrush of the tropical jungle.

In this southern wonderland, our only National Forest in the tropics, parking lots, swimming pools, marked trails, overnight cabins, and uniformed rangers of the Department of Agriculture recall similar reservations in the States.

Puerto Ricans love the refreshing coolness of these former Crown lands of the King of Spain, and flock here for holidays. Horse and foot paths wind still higher through dense dwarf-type forests, with century-old trees no higher than a man, to the summit of El Yunque, 3,496 feet above the sea.

"DEVIL WITH HAT OF STRAW"

On my first long trip out of San Juan I was accompanied by Señor Robert, my friend and interpreter, and a chauffeur whose name neither of us learned, but whom we promptly christened "the devil with hat of straw." *El Diablo* was a skilled, if somewhat reckless driver, who delighted in whirling around the curves with horn blaring and tires screaming.

To visitors, the Puerto Rican habit of sounding the horn loudly and continually seems an unnecessary bit of exuberance, but it is required on all curves or when the way is not clear. A man who rented a car found the brakes, lights, and horn all defective. He went back to the agency and complained.

"What!" exclaimed the owner of the car. "No *horn,* señor! I shall get you another car pronto."

With more than 1,200 miles of paved and wonderfully scenic roads, Puerto Rico might be a motorist's paradise. Until recently the island had no road signs, and the present ones give the distances (in kilometers) only to the next town.

Later, when I obtained a driver's license and did my own driving, I was often lost. To my questions passers-by invariably said, *"Sí, señor,"* in the pleasantest manner possible, but sometimes I had to retrace many miles.

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PAGEANTRY OF OLD SPAIN SPRINGS TO LIFE AGAIN AT CARNIVAL TIME

This señorita was one of the candidates for Carnival Queen during the island's 1939 merrymaking that precedes Lent. Clad in regal splendor, she pauses on the veranda of the Spanish Club, in San Juan (Plate X). Puerto Rico, known to the Spaniards as the "ever faithful colony," was the last bit of Spain in the New World. Its conquest by American troops in 1898 was halted by the armistice that ended the Spanish-American War. A key to the Panama Canal, the island is now an outpost of American defense.

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U. S. S. "WYOMING" STEAMS OUT OF SAN JUAN HARBOR, SKIRTING A SENTRY BOX ATOP THE OLD CITY WALL

The battleship was one of numerous Navy units which visited the port during the fleet maneuvers last winter. In the left distance is Isla Grande, site of the Naval Air Station, which is being built on land dredged from the bay to widen the channel and provide a turning basin for big ships.

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HISTORIC CASA BLANCA WAS BUILT FOR PONCE DE LEON

The famous seeker of the "Fountain of Youth," who was Puerto Rico's first governor, never dwelt here, for he died before the bougainvillea-festooned building in San Juan was completed in 1523. Today it is the home of the commander of the U. S. troops on the island (Plate XI).

Kodachromes by Edwin L. Wisherd

LUMBERING OXEN HOLD THEIR OWN AGAINST TRUCKS AND HORSES

Tons of sugar cane, Puerto Rico's chief crop, are milled by modern machinery, but the island still depends largely on these patient beasts to transport the raw material from the fields. Here, near Mayagüez, flaming bougainvillea flanks a lane at the Agricultural Experiment Station.

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SURF POUNDS THE SAN JUAN COAST FROM FORT SAN CRISTÓBAL'S "HAUNTED" SENTRY BOX TO EL MORRO'S OLD FORTRESS

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FROM YAREY PALM, GIRLS DEFTLY WEAVE MATS AND BASKETS

Both giant sombreros and more conventional straw hats are made in this Aguadilla workshop on the west side of Puerto Rico (Plate VII).

Kodachromes by Edwin L. Wisherd

INTRICATE DESIGNS FAIL TO DAUNT HER NIMBLE FINGERS

Puerto Rican women, in shops and at home, skillfully fashion fine embroidery and drawn work, which is sent to shops on the mainland.

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Kodachrome by Edwin L. Wisherd

MACHETES IN HAND, PUERTO RICAN HARVESTERS ATTACK A FIELD OF TALL SUGAR CANE

They cut stems, about 12 feet tall, at ground level. Leafy tops are hacked off and the stalks are carted to the mills by oxen (Plate III).

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"HAT" PALMS—BEFORE AND AFTER

Dried leaves of these stocky yarey palms are woven into huge headpieces. Most of the weaving goes on in west coast towns, close to the groves (Pl. V).

Kodachromes by Edwin L. Wisherd

GOLDEN GRAPEFRUIT GLEAM FOR MILES WEST OF SAN JUAN

In Puerto Rico's citrus belt, pineapples also carpet thousands of acres. Oranges, limes, papayas, and mangoes are other island fruits.

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Kodachrome by Edwin L. Wisherd

FROM HIS LOFTY PEDESTAL, MUÑOZ RIVERA GAZES OVER THE PLAZA IN PONCE

Political and social leader, he gained semi-autonomy from Spain for Puerto Rico just before the Spanish-American War. Later he served as resident commissioner in Washington, D. C. Fronting on the Plaza of this south coast city stands the old Church of Our Lady of Guadeloupe.

From Santurce a long causeway crosses the mangrove swamps at the head of the harbor. We paused at the site of Caparra, grandfather of all Puerto Rican towns (page 703). Founded in 1509 by Ponce de León, it was abandoned two years later in favor of the rocky island of San Juan.

HERE LIVED THE SEEKER OF ETERNAL YOUTH

One of Puerto Rico's eminent historians showed us the remains of the packed-earth walls and tiled floors of the great house of the seeker of eternal youth. In a small museum are beautiful blue 16th-century tiles from Seville, old coins, perfume bottles, water jugs, and extra-wide horseshoes (to prevent the horses from sinking in the swampy ground near by).

Bayamón, a cigar-making and grapefruit-canning center, is flanked by many attractive country estates. Puerto Rican grapefruit (Plate VII) is delicious, but most of the groves are now neglected and the fruit rots on the ground. Debts following hurricanes and competition from Texas and Florida have virtually destroyed an industry that once shipped thousands of boxes to New York.

A few canneries are still in operation. Cans from the States are received smashed flat (to save shipping space) and an ingenious machine restores them to shape.

In a spreading grove of coconut trees near Dorado I was treated to a drink from "nature's first refrigerator"—a green coconut. No matter how hot the day, the milky water inside is refreshingly cool. Scores of workmen were husking dried coconuts and passing the brown-shelled kernels through different-sized iron rings for grading. Packed in burlap bags, they are shipped off to northern markets. The charred shell is now used in gas masks.

The rug-weaving plant near Vega Baja, a busy place, turns out broadloom rugs, which find ready sale in the island.

Green fields of waving sugar cane flanked the road on each side and spread inland to the mountains as we drove through the pleasant countryside to Arecibo, thriving city of rum, cotton, needlework, and fruits, as well as the inevitable sugar cane.

Near Isabela the highway wriggles through the foothills and comes out for a breathless view of the rocks and sea at the mouth of the Guajataca River, one of Puerto Rico's dramatic spots. Isabela is preparing for its share of the trade from the great new Army Air Base being built near by. A new movie theater (Spanish subtitles are added to our regular "talkies") and cafés already are there.

Before we reached Point Borinquen, however, we halted at the Isabela Agricultural Substation of the University of Puerto Rico. On several acres of well-irrigated ground we were shown papayas as big as watermelons (page 711), sea isle or long-fiber cotton, knee-high alfalfa, and tall stands of corn and sugar cane.

On my first visit to Point Borinquen, only a few surveyor's flags gave any hint that this was soon to become one of the United States Army's most important outlying air bases. Three weeks later I returned and found a tent city of the 65th Infantry and a cleared area more than 1,000 feet long.

Plans call for a huge military establishment here, occupying an area of 1,600 acres. There will be hangars, shops, barracks, hospital, schools, warehouses and paved runways long enough for the Army's largest bombers—the famed "flying fortresses." A village, several small farms, hundreds of palms, and a number of roadways will disappear in the "face lifting."

WHERE COLUMBUS "REFUELED"

The hills come down to Aguadilla, so the town is built close to the sea. Here I saw youngsters bathing in a basin fed by the same spring at which Columbus may have filled his water casks. South of town a monument, recently repaired and embellished with a little park, marks the spot where the discoverer came ashore during his second voyage to the New World in 1493. This is the only region now under the American flag which was visited by the great admiral.

Mayagüez looks new, despite its grilled balconies, pastel-colored houses, and central patios gay with potted flowers. It should. The town was nearly destroyed in 1918 by an earthquake and tidal wave that took hundreds of lives. But its citizens soon rebuilt their homes and offices and today the city is one of the healthiest and most prosperous on the island.

Mayagüez until recently was center of the needlework and clothing trade. Cigars are still made by hand here, to the accompaniment of a staccato Spanish lecturer who entertains while he prevents casual

Photograph by E. John Long

BACK WITH THEIR CATCH OF LAND CRABS

Gathered along the roads at night, crabs are strung together and sold by boys in all the principal markets. After being boiled, the meat is scraped from the shells, mixed with ham, green peppers, olive oil, and seasoning. The mixture is then returned to the shells, covered with an egg, and baked. Tropical fruits are displayed here in Ponce, Puerto Rico's second largest city.

conversation. Other factories make furniture, beer, rum, chocolate, and tiles.

But Mayagüez's chief claims to fame are two institutions on the outskirts of the city: the College of Agriculture and Mechanic Arts of the University of Puerto Rico, and the noted Experiment Station of the U. S. Department of Agriculture.

SPICES THAT COLUMBUS SOUGHT

The latter must be paradise indeed for the botanist and horticulturist. On its extensive grounds or near by grow spices and herbs, fruits and flowers, vines and grasses gathered from all over the tropics. Here truly are recreated the "Spice Isles of the Orient," in quest of which the New World was found!

What would the great Columbus say if he could see, twenty miles south of the spot where he set foot on Puerto Rican soil, cloves, pepper, cinnamon, allspice, ginger, nutmeg, camphor, and scores of other rare and exotic things!

Here I photographed vanilla vines climbing chocolate trees (opposite page). I saw plants which yield poisons deadly to insects but harmless to man. I tasted the mangosteen, which Queen Victoria once called "the most delicious fruit in the world." I smelled the green blossoms of the ylang ylang tree, whose fragrance "makes strong men tremble and women swoon!" I nibbled bitter cinchona bark, source of quinine for malaria. I sat in furniture made from a solid bamboo impervious to the powder-post beetle. I looked at, but, recalling my Homer, refrained from eating the lotus!

In a "living drugstore" aloe (for X-ray burns), coca (source of cocaine), strychnine, citronella, quinine, and camphor flourish under the tropic sun.

Many are the activities of this botanical wonderland, but its greatest accomplish-

ment was a few years ago when a mysterious blight laid whole fields of sugar cane low.

A TOAD RESCUES AN INDUSTRY

The islanders were in despair until it was discovered that the white grub of a beetle was responsible. The Experiment Station set out to find an enemy. After patient research the "Bufo frog," really an amphibian toad (*Bufo marinus*, Linné), was introduced from Barbados and Jamaica. It throve on the grubs and beetles and delivered an industry from ruin.

Once each year, on September 8, the lame, the halt, and the blind of Puerto Rico make pilgrimage to the village of Hormigueros. In a little white church dedicated to the Virgin of Montserrat many of the faithful come to pray for restored health—and many more to beg for alms.

Photograph by E. John Long

CHOCOLATE OR VANILLA ON THE "SODA FOUNTAIN" TREE

In his right hand the scientist holds a cacao pod; in his left the leaf of a vanilla vine, which zigzags up the trunk of the tree whose seeds are the source of chocolate. Vanilla is a terrestrial orchid, and the popular flavoring is derived from long podlike capsules which, when dried, resemble flattened stogies. This photograph was taken in a grove at the U. S. Department of Agriculture Experiment Station, Mayagüez.

Driving south from Mayagüez in the early morning we soon came in sight of Hormigueros and its gleaming white church high on the green hillside.

It was nearly nine o'clock and time for the procession. From the belfry the church bells, pounded by men with hammers and stones, set up a furious clangor like a dozen switch engines. Back of the church three skyrockets were set off. Then from the portal came a slow procession, led by church dignitaries, pilgrims carrying banners, girls dressed in white, and finally a slow-marching, perspiring group of men bearing on their shoulders a rose-covered catafalque containing the image of the Virgin.

Once around the church they staggered to the cadence of the bells. They kept a strange pace, like a bolero, and the catafalque swayed as if in a heavy sea.

There is a legend back of this Puerto Rican equivalent of Mexico's Guadalupe. "Some three hundred years ago," the padre of the church told us, "a peon was plowing his field near by when he saw a bull

Photograph by Edwin L. Wisherd

"LIKE A CRUMPLED PIECE OF GREEN PAPER"—PUERTO RICO'S MOUNTAINS

Most of the interior of the island is covered with irregular, tumbling ranges from which the original trees have been stripped by charcoal burners. Here, near the Maricao Insular Forest, attempts are being made to grow mahogany, and to establish new coffee plantations.

Courtesy U. S. Dept. of Agriculture

HOW FAST DOES A PUERTO RICAN HILLSIDE SHED WATER?

On plots of similar size and slope the Soil Conservation Service of the U. S. Department of Agriculture at Mayagüez experiments with different types of grasses to determine moisture and soil loss. Concrete aprons and pipes at the foot of each plot collect the run-off after a rain, and pour it in the stubby silos with conical roofs. There scientists measure and compare the deposits.

Photograph by Ralph Kestly

CHEMICAL WARFARE AND CHATTERING MACHINE GUNS DISTURB THE PEACE OF COCONUT PALM GROVES

Donning gas masks, a unit of "Puerto Rico's Own" shows that it is ready for any emergency as the island assumes new importance as a watchdog of the Panama Canal. The "gas" is a harmless mixture of chemicals used for practice. The 65th Infantry is composed of native Puerto Rican troops trained in maneuvering over mountains and through tropical jungles.

© Abrams Aerial Survey Corp.

LIKE A SMALL CITY IS THIS SUGAR REFINERY AND DISTILLERY NEAR PONCE

Surrounded by the green fields of cane from which comes its lifeblood of sugar juice, the *Central* Mercedita combines in one unit industrial plants making raw and refined sugar, rum, and molasses. It has its own railroad system, homes for workers and officials, stores, offices, swimming pool, and water system. Out of the picture to the left is the factory's airport, with a fleet of planes that carry its executives about the island and to Miami, Florida.

charging down upon him. The peon fell to his knees and invoked the aid of the Virgin of Montserrat. The bull was frozen in his tracks. When the peon told the story the peasantry decided that a church, dedicated to the Virgin, should be built on the hill overlooking the spot."

South of Hormigueros the scenery changes. As we rode along, palms, bamboo, flamboyant, breadfruit, and all the green things of the jungle disappeared. Cactus and aloe sprang from the dusty roadsides (Plate XV). Dry grass covered the hillsides where long-horned cattle grazed. The country looked like Texas. Several times we stopped to let cowboys and herds of longhorns pass.

We were bound for the salt pans near Boquerón. In this desolate region, where the sun beats down with pitiless ferocity throughout the year, sea water is admitted to shallow lagoons and evaporated. The residue is almost pure salt (page 711).

San German has a polytechnic institute and the oldest church (1511) under the American flag. Guánica claims three superlatives—first landing place of Ponce de León and his colonizers in 1508; first landing place of American troops in 1898; and the largest sugar mill on the island.

Leaving the shore road, we struck north through the mountains to Lares, scene of the abortive revolution against Spain in 1868. High in the hills and cool, Lares seems least changed of Puerto Rican towns.

This is coffee country. On the winding road to Adjuntas the hillsides were covered with shiny-leaved coffee bushes growing under the protecting shade of guava trees.

PONCE, AN INLAND SEAPORT

Crossing the backbone of the Cordillera Central, within the shadow of Cerro de Punta (4,399 feet), we twisted down a spectacular highway into Ponce, second city of Puerto Rico.

Ponce is listed as a seaport, yet, like Los Angeles, the town lies several miles inland on a little plain backed by towering mountains. Railroad and paved highway link it with the busy docks of Playa Ponce.

I visited a modern coffee roasting and packing plant where thousands of sacks of Puerto Rico's finest green coffee are roasted a chocolate brown, after which some of it is packed in paper sacks for domestic use, and the rest is ground and canned by vacuum process for export.

Ponce has Puerto Rico's largest and most colorful market. At sidewalk booths, fruits, vegetables, wearing apparel, and furniture are spread in picturesque disarray.

I spent the night at El Semil, a typical old coffee *finca,* high in the hills above Villalba. We arrived after dark in a heavy rain, one of those tropical downpours when the water is unleashed in bucketfuls.

But it was dry at the old plantation house, cupped in towering mountains. Comfortably seated in the booklined living room, before a blazing log fire, I sipped coffee grown and roasted on the *finca* as I talked with the owner of the plantation.

A SPOONFUL FOR THE INDUSTRY

When I declined sugar with my coffee, my host calmly told me to throw a spoonful over my shoulder.

"Why?" I asked.

"For the industry!" he replied with a laugh, adding that he had a Puerto Rican friend who, wherever he went, always took one lump of sugar for his coffee and another for his pocket—the latter to help use up some of Puerto Rico's sugar surplus!

That night I slept under blankets and without a mosquito net for the first time since coming to Puerto Rico. Lulled by a rushing mountain stream, the dripping of water from banana leaves, the insistent "co-kee" of the tree frog (dubbed the principal "songbird" of Puerto Rico), and other sounds of the jungle night, I was about to fall off to sleep when I saw a greenish light moving ghostlike down the wall of my room! Quickly turning on the light, I discovered it was a glowworm, the *cucubano.*

Early next morning, after a dip in the fern-shaded swimming pool, my host showed me coffee berries, like green cherries, in shaded groves that ran up the steep mountain slopes encircling the *finca* on three sides. The fourth side commanded a magnificent view of foothills that seemed to roll and tumble over each other down to the blue Caribbean. We were 1,700 feet above the sea and the air was as cool and crisp as Maine in summertime.

Returning to the Carretera, or old Spanish military road, we drove through rich farming country toward Coamo. A side road led to a manganese mine. Operations were suspended, but if demand and price return for this essential ingredient of high-speed steel, Puerto Rico is ready.

Later, at the Insular Bureau of Mines, I

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SPANISH GRANDEES ONCE PACED THE BALCONY OF LA FORTALEZA

Governors have maintained their homes and offices here for four centuries. When Puerto Rico became a part of the United States after the Spanish-American War, the custom was continued. The old palace, originally intended as a fortress, now is the headquarters of Governor William D. Leahy.

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Kodachrome by Edwin L. Wisherd

GRASS COVERS MOAT AND TIME-WORN WALLS OF SPANISH FORT SAN CRISTÓBAL, WHICH WAS SHELLED BY A U. S. FLEET IN 1898

In contrast, the marble dome of Puerto Rico's modern Capitol beyond gleams in the sun. Buses parked on the street await the evening rush of homebound workers. Flanking the Capitol are (left) the School of Tropical Medicine and (right) the Spanish Club with its blue-and-white-tiled roofs (Plate IV).

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GROTESQUE FLOATS AND FIGURES TAKE OVER SAN JUAN STREETS AT CARNIVAL TIME

Kodachromes by Edwin L. Wisherd

WATER LILIES BLOOM IN A SEQUESTERED POND ON THE GROUNDS OF CASA BLANCA (PLATE III)

PUERTO RICO BREADFRUIT TRACES ITS ANCESTRY TO THE SOUTH SEA

Mutiny on the *Bounty* thwarted Captain Bligh in his first effort to bring the trees to Caribbean lands from Tahiti. On a second cruise, in 1792-3, he was successful, arriving with about 700 plants.

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FLAMING COLORS FLASH FROM PUERTO RICAN RUGS OF COTTON CORD

Used on tile floors or for automobile seat covers, they are eagerly bought by visitors from the mainland.

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THIS HOLE IS EASY, BUT ON THE NEXT THEY MUST DRIVE OVER THE WALL (RIGHT)

Part of the U. S. officers' golf course at El Morro, in San Juan, is laid out through this old moat. The sentry box at left is a part of the original fortress, but the lighthouse tower (background), which overlooks San Juan Harbor, has been built since the Spanish-American War.

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COMET CLASS YACHTS IN SAN JUAN HARBOR HEAD FOR THE STARTING LINE AT PUERTO RICO'S MIDWINTER REGATTA

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TURK'S-CAP CACTI DOT THE DESERT LANDS OF CABO ROJO

The arid southwest corner of Puerto Rico is cut off from rain-bearing trade winds by highlands.

Kodachromes by Edwin L. Wisherd

GIANT FERNS FORM ARCADES ON LUSH EL YUNQUE SLOPES

At the eastern end of the island, plentiful rains bring luxurious growth in the Caribbean National Forest.

PONCE FIRE FIGHTERS GO MODERN, BUT KEEP OLD EQUIPMENT IN USE, TOO

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ALL THE COLORS OF THE SPECTRUM COMBINED IN ONE SMALL CATCH

Fishermen near Parguera pull in these gaily colored tropical fish every day. Blue and black angel fish, blue-striped grunts, queen trigger-fish, pork fish, and squirrel fish are among the varieties here.

was told that there was also iron ore near by. When hydroelectric plants, now in construction, are completed, Puerto Rico may some day be a producer of ferro-manganese by electricity.

Coamo Springs, in the foothills, is Puerto Rico's oldest resort. Baths, with a constant flow of warm mineral water, have attracted health seekers to this quiet inland retreat since Spanish colonial days.

8,000 IN A THIMBLE!

In Guayama sugar again was a byword, but I was more interested in a factory where jewels, used as bearings in precision instruments, are cut with uncanny skill and accuracy by Puerto Rican girls. I looked in amazement at these women as they turned tiny sapphires on lathes, and, with diamond chips, trimmed them to size.

The manager explained that so keen are their eyes that they are able to cut a V-shaped groove to within 2/1000ths of an inch accuracy for depth and diameter! The dimensions are tested before the settings are shipped to New Jersey to become bearings in light meters, ammeters, voltmeters, milliammeters, and other precision instruments. Eight thousand of these bearings can be put in a thimble!

At near-by Arroyo is *Central* Lafayette, a co-operative sugar refinery with a modern distillery for the manufacture of solvents. In the laboratory of the plant, nearing completion, I was shown how butyl alcohol, acetone (essential for explosives in war time), and ethyl alcohol can be obtained by fermentation from the molasses by-product of the sugar refinery.

Returning to San Juan by way of the spectacular Guayama-Cayey Road, I passed a mountainside colony of beautiful homes at Jájome. Here the Governor has a summer residence, an aerie far from the heat, noise, and confusion of city life.

Cayey, high in the hills, is headquarters of the 65th Infantry, "Puerto Rico's Own" (p. 726). Like Baguio, in the Philippines, Cayey is cool and pleasant the year around.

Higher and even pleasanter, at least to those of northern blood, is Aibonito. Here, some 2,000 feet above the sea, and on the old Spanish road linking San Juan and Ponce, I saw daisies growing in green meadows like those of Pennsylvania.

A detour off the main road led to Cidra, and the "Treasure Island" resort. Despite its name the latter is not an island and its only "treasure" is golden pineapple, growing in long rows. "Treasure Island" is best known for its palm-thatched restaurant and quaint overnight cabins scattered about the mountainside.

At Caguas, with its busy Plaza, Dominican mahogany is carved and polished into beautiful serving trays, bookends, and other souvenirs. Caguas is the focus of a rich agricultural region, shipping tobacco, coffee, sugar cane, cucumbers, potatoes, cheese, and pineapples by truck to San Juan.

In the mountains lives the *jíbaro,* which literally means "escape from civilization," Puerto Rico's most distinctive type.

They are shy folk, these thin, good-natured mountaineers with pallid complexions and high cheekbones. Hardworking and peaceable, they lead a precarious existence on land which barely supports their large families.

Ragged he may be, but, as a gentleman justified in demonstrating his right of self-defense, each carries a long *machete.* Like a Spanish grandee he enters the humble homes of his friends without his *machete,* which he places on the steps in the custody of his host.

In a rented roadster I went on *safari* to Santiago, the monkey island (pages 706 and 738). I say "safari" because I had with me, on the 60-mile drive from San Juan to Playa Humacao, Mr. and Mrs. Tomilin, the curators of the monkey colony, their baggage, food supplies, and "Mit." "Mit" was an orphaned baby monkey who had to be taken everywhere by the Tomilins because he was being bottle-fed each hour.

"HAREMS" ON "MONKEY ISLAND"

Santiago, a palm-fringed islet a half-mile offshore, we reached in a white-winged sailboat. A monkey "reception committee" at the pier scurried into the palms as we climbed a hill to the Tomilins' cottage.

No ordinary house is this home which the Tomilins call their "chicken coop." Doors and windows are heavily screened, with latches inside and out to guard against mischievous and predatory monkey visitors. Although rhesus monkeys were the amusing "jungle folk" of Kipling's *Jungle Book,* they are not exactly pets. A full-grown male weighs 35 pounds and will inflict painful scratches and bites if cornered.

Life is comparatively quiet on Santiago now, I was told. During the first few weeks after arrival last year, much of the curators'

Photograph by E. John Long

MONKEYS COME TOP SPEED WHEN THE DINNER PAILS RATTLE

On Santiago Island, off the eastern coast of Puerto Rico, an attempt is being made to raise rhesus monkeys of known ancestry for sale to zoos and scientific institutions (pages 706 and 737). In less than a year more than 70 have been born. Puerto Rico has no native monkeys.

time was taken up in refereeing fights between the big males. First there was strife over the division of females and then over the amount of territory each male could boss. But "harems" have now been established and 17 feeding stations have been placed in the 17 areas selected as "domains" by the more aggressive males.

Puerto Rico has several large outlying islands, one of which, Mona, recently has been developed by the Forest Service as a game-fishing and hunting preserve.

On September 11, I stood on the steps of the Capitol at San Juan as Admiral William D. Leahy, former Chief of Naval Operations, was sworn in as Governor (page 698). His inaugural address, one of the shortest on record, touched directly and frankly upon some of the pressing needs of the island.

"We are today faced with a multitude of problems, many of which demand solution without delay," he declared.

"Some of these problems are capable of solution by local action, and some require corrective action by the Federal Congress. Among the latter are changes in the sugar quota, modification of the local application of the Wages and Hours Act, correction of the shipping situation as applied to Puerto Rico, unfavorable trade agreements with foreign nations, and the Hurricane Relief Commission debts."

As I left the island I sensed, however, a new spirit of optimism in every walk of life. The President's suspension of the sugar quota in September will allow Puerto Rico to harvest, in 1940, all of its mature cane. That means at least 1,000,000 tons as compared with the government-restricted harvest of 851,000 tons in 1939. Also, Puerto Rico was able to sell immediately 300,000 tons of surplus sugar stored in warehouses.

The addition of 2,000 officers and men to military garrisons releases a payroll equal to several new industries.

Most gratifying of all to the islanders, however, is something quite intangible. They feel, and rightly, that Puerto Rico has again taken its proper place in the national spotlight. They are proud of its new, yet historic, role of "Watchdog of the Caribbean."

HEART OF A HEMISPHERE

Of Vital Importance is the Area Portrayed in The Society's New Map of Mexico, Central America, and the West Indies

FROM the day of the explorer's caravel to the modern age of flying clippers and aerial armadas, the romantic region of the Caribbean has played a vitally important part in the destiny of the Americas.

Never has its importance been greater than today when the alarms of a war-troubled world turn thoughts to problems of defense of the Panama Canal and to cooperative efforts among the 21 neighbor Republics of the Western Hemisphere.

This region, then, one of the world's main crossroads, is the subject of the National Geographic Society's latest ten-color map which reaches more than 1,100,000 member-families as a special supplement to the December issue of THE GEOGRAPHIC.

In a year of unparalleled cartographic activity, a total of 4,400,000 large colored maps have been issued to members, giving accurate and detailed geographic information on such diverse areas as New York City and vicinity (April), the world that rims the narrowing Atlantic (July), Central Europe and the Mediterranean (October), and now the Caribbean region.

HIGHLIGHTS OF HISTORY IN RED

This new map of Mexico, Central America, and the West Indies recalls one published five years ago, which proved to be in such demand that the edition of more than a million copies is now out of print. Aviators, ship captains, military men, students of history and current events, vacationists cruising Caribbean waters, business men with their eyes on Latin-American trade, armchair travelers to whom such a map is a magic carpet—all will find the new supplement even more satisfactory.*

Among the improvements are the historical notes, printed in red, which give this modern map a sort of fourth dimension. Through them one can peer into the past of the Caribbean, and may travel vicariously both in space and in time.

FOUR POWERS HAVE NAVAL BASES HERE

These sunny waters, tropic isles, and adjoining continental shores form a locality of primary interest whether peace or war prevails. Here is the heart of the Western Hemisphere, and its vital arteries—the Panama Canal and the sea lanes converging toward it. Sixteen flags fly in this area. Eleven naval bases protect the varied interests of four world powers, the United States, Great Britain, France, and the Netherlands.

If the ocean could be drained away, this would be by far the most spectacular spot in the whole Atlantic basin. The Caribbean and Gulf of Mexico are not mere submerged parts of a continental shelf, as are Hudson Bay, the North Sea, or the Baltic. The Caribbean alone, which has an area about equal to those three seas together, has a volume 26 times as great; in area it is a little smaller than the Mediterranean, but the Caribbean is about twice as deep, averaging one and two-thirds miles.

In reality, the West Indies are a huge mountain system, rising from the ocean floor. From the greatest depths to the highest peaks, they rise five and six miles on the Caribbean side, six and seven on the Atlantic. Forces which created them are still active, as earthquakes, volcanoes, and submerged cities so dramatically attest.

AMONG THESE ISLES GROPED COLUMBUS

In keeping with its cataclysmic geological history, the record of men in this region is as dramatic as an eruption of Mount Pelée, or an equinoctial hurricane.

Here Columbus came in 1492, and in his wake there followed the Conquistadors: Ojeda, fearless, with an absolute faith in his invulnerability; Balboa, who, to escape his creditors, smuggled himself from his farm on Hispaniola to the mainland in a large cask; Pedrarias, by whom Balboa was beheaded; Pizarro, Cortés, Alvarado, De Soto, Córdoba, to mention only a few.

* Members wishing additional copies of the map, "Mexico, Central America, and the West Indies," may obtain them by writing the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen; index, 25¢. Outside of U. S. and Possessions, 75¢ on paper; $1 on linen; index, 50¢. Postage prepaid.

Photograph by Ralph Kestly

MAPPING PLANS FOR DEFENDING AMERICA'S RAMPARTS IN THE CARIBBEAN

At San Juan, Puerto Rico, Brigadier General Edmund L. Daley consults with his staff concerning the defense of this West Indian outpost (page 697). General Daley, commander of the new military department of Puerto Rico, points out the location of Cayey, interior city, where the 65th Infantry, "Puerto Rico's Own," has its headquarters (pages 726 and 737).

Here lurked the buccaneers who took their toll from the rich stream of treasure.

Columbus' route to the East was never found here, but the United States dug one. The Panama Canal, "dividing the continents and uniting the world," also created a lifeline between the Nation's east and west coasts.

A large-scale inset of St. Thomas, seat of government in the American Virgin Island group, has been added to this new map. When the United States paid Denmark $25,000,000 for St. Thomas, St. John, and St. Croix in 1917, they were considered enormously expensive real estate, but the map, showing the relationship of these islands to the Anegada Passage, one of the main thoroughfares from Europe to the Panama Canal, emphasizes their value.

The American Virgins, lying south of Bermuda and Nova Scotia, are the easternmost outpost of the United States. As a strategist might put it, they flank the Atlantic approach to United States shores, and they extend the chain of canal defense (through Guantánamo and Puerto Rico) 1,100 miles from the mainland.

Outstanding among roads shown on the map is the Inter-American Highway, completion of which will open an interesting region to travel and trade and give the United States a fast land route to the Canal Zone.

All through the Central American Republics, interest in the project has been stirred by the success of the northern section, from Laredo, Texas, to Mexico City. Of the total distance of 3,267 miles from Laredo to Panama, 1,123 miles have been paved, including about 842 miles in Mexico, 163 in Panama, and the rest in El Salvador, Nicaragua, and Costa Rica.

In addition, there are 669 miles of improved all-weather road, including the whole Guatemala section.

That makes 1,792 miles now open to automobile traffic. Of the remaining 1,475 miles, 653 are classed as dry-weather roads and 822 miles as trails.

This ultra-modern road will thread a region of ancient civilizations. Among them is the vanished empire of the Maya, whose artisans were chiseling dates on stones long before the time of Christ.

CATHEDRALS OF ENGLAND

An Artist's Pilgrimage to These Majestic Monuments of Man's Genius and Faith

By Norman Wilkinson

With 16 Pages of Dry-point Engravings by the Author

THE cathedrals of England. What a picture of color and romance such a phrase conjures up! It seems to embrace the glowing history of this country.

For hundreds of years these sentinels of man's genius have stood, the pageant of centuries eddying round them. Kings and queens have ruled and died, religious fanaticism and civil war have passed them by.

While Drake raided the Indies, or the Spanish Armada swept up the Channel, Canterbury stood as it stands today, serene and beautiful, its bells ringing out over the quiet countryside. Four hundred years ago men saw its exquisite form as we see it now.

Who can look unmoved at the surcoat hanging above the tomb of the Black Prince at Canterbury or see the scabbard of the sword he held in battle in the 14th century? Time seems nonexistent as we reconstruct this immortal figure of history.

MASTERPIECES OF MANY HANDS

Little is known of the actual designers of these superb monuments. Many hands went to their making, but the genius of their work is an endless source of wonder: poems in stone, glorious stained glass, and carving unsurpassed in any age.

The Civil War shook their serenity a little; the fanaticism of Cromwell's soldiers despoiled them in some measure; but they survived and stand, showing scars which detract little from their beauty.

I do not purpose to give a guidebook description of the cathedrals with this series of dry points. It will not come amiss, however, if I touch briefly on a few of the more interesting facts connected with some of them. Each has its own particular character and atmosphere, resulting from centuries of legend and fact.

In writing of English cathedrals and all the romance surrounding them, one immediately thinks of Canterbury (Plate I). Founded by St. Augustine, who consecrated a Roman church already standing, it has been the scene of fire and pillage down the centuries. It was damaged by the Danes, burned the year after the Conquest, rebuilt, enlarged, until finally the cathedral as we see it today was completed in 1495.

GLASS REMOVED AS WAR PRECAUTION

Recently the most precious medieval stained glass has been removed from the windows of Canterbury and other cathedrals as a precaution against its destruction in wartime.

Canterbury will always be associated with the murder and martyrdom of Thomas à Becket. For centuries the pilgrimage to the martyr's tomb was one of the most popular in the Western church. It was at his shrine that Henry II made atonement by public penance.

A pulpit made from historic stones of Canterbury is one of the prized possessions of the Cathedral of St. Peter and St. Paul in Washington, D. C.

Ely, dominating the countryside for miles, embracing every style of architecture from early Norman to late Perpendicular, stands a lasting tribute to man's genius (Plate V). Its wonderful Galilee Porch and Decorated octagonal tower and lantern, to name only a few of its glories, make one realize how little we have advanced today in the creation of the beautiful. To what building can we point in our own age that will so enthrall the beholder for hours with exquisite carving, stained glass, and superb architecture?

Often, as I walked in these cathedrals, I endeavored to reconstruct the scene of the actual building. What were these long-departed men like? From what plans did they work? How were the masses of masonry raised to their final resting places? We talk lightly today of genius; the builders of these cathedrals certainly deserve that title.

STALKING A CATHEDRAL

One of the chief difficulties I encountered in obtaining my sketches of exteriors was to find a point of view. In almost every

Photograph by Clifton Adams

PETERBOROUGH ROSE FROM ASHES OF A FIRE "KINDLED BY THE DEVIL"

According to the *Saxon Chronicle,* kept by the monks, one August day in 1116 some difficulty was experienced in kindling a fire in the bakehouse of the old monastery. "John, the Abbot, being present seeming in a choleric mood, cried, 'The devil kindle it,' and presently the fire flamed to the top of the house, ran through all the abbot's offices and then to the town. . . . The whole of the monastery was burnt and the greater part of the town was burnt also." The year after, Abbot John began to build the present cathedral, which was completed early in the thirteenth century. The three lofty arches, deeply recessed and rising nearly to the summit of the façade, are unique in England (Plate XII).

case a cathedral is in the center of the city, surrounded by buildings, ecclesiastical and otherwise, which have grown up through the centuries. Streets are almost always narrow, and, while lovely glimpses are caught from various angles, it is a matter of considerable difficulty to get a clear view which will do justice to the subject.

Nearly always there is a good point of view, but so close that the perspective is overpowering and, when sketched, suggests distortion. The discovery, therefore, of the ideal place from which to get a sketch which would be comprehensive and yet good in composition called for a considerable amount of exploration.

Frequently a fine distant view could be found, but too far away to be practical for drawing. Ely Cathedral was a good illustration of this. Although it stands high and dominates the surrounding country, it was rapidly lost to view on nearer approach. Intervening trees and buildings hid it until I had driven right up to the cathedral itself.

Having investigated the possibilities of a close-up sketch, I drove slowly away down roads radiating from the city, stopping constantly to look back. Time after time conditions seemed to be developing well, only to be spoiled by some obstruction.

At last I found the view in Plate V. This was too near to show the whole cathedral, but the composition seemed good and I was able to get a satisfactory view of the lantern tower.

WESTMINSTER, WHERE KINGS ARE CROWNED

Westminster Abbey presented many difficulties. The interior is cluttered with Victorian sculptured groups, vast heroic statues embodying all the flamboyant heraldry of the period, plaques and busts without number. Movements have been set on foot at times to remove many of the larger groups to some more fitting place

© J. Dixon-Scott

MASSIVE-DOMED ST. PAUL'S BROODS OVER LUDGATE CIRCUS IN LONDON

Sir Christopher Wren designed the famed cathedral, his masterpiece (Plate IX), to replace the old church destroyed in the Great Fire of 1666. The first religious building on this site was erected in 604 and succumbed, like all of its successors except the present one, to flames. The photograph was made from Fleet Street, home of many London newspapers. Because streets and buildings on all sides hem in the large structure, it is difficult to visualize its vast proportions.

and so to reveal the simple beauty of this national treasure, but so far they have met with no success.

The exterior is equally difficult. I found only one point of view from which the abbey could be well seen and that a frontal one. This, however, could not be regarded as satisfactory. At last it seemed to me that the fine Rose Window in the south transept was as characteristic as any aspect (Plate XVI).

Each one of these cathedrals has some feature of interest peculiar to itself.

It is at Gloucester (Plate XIV) that the vaulting shows the earliest example of fan tracery, afterward copied in the Henry VII Chapel at Westminster. The wooden effigy of Robert, Duke of Normandy, eldest son of the Conqueror, is of great interest, and also the tomb of Edward II, who was murdered at Berkeley Castle and buried here in 1327.

Winchester is so rich in history that it is difficult to speak of it briefly (Plate II). Here the earliest kings came to worship and were buried; Egbert, first King of all England, lies here; so do Ethelwulf, Canute, Hardicanute, and William Rufus. Here was crowned Edward the Confessor and this cathedral saw the pomp of Mary's marriage to Philip of Spain.

Wells is famed for its wonderful front, fine stained glass, and 350 sculptured figures (Plate VI).

Salisbury's beautiful 14th-century spire dominates the plain, and gleams like a jewel in the sun (Plate VIII). Floodlighted at night as I have seen it, the spire of Salisbury seems unreal.

A LEGEND OF LICHFIELD

Lichfield with its three spires presented one of my chief difficulties from a sketching standpoint. Near-by buildings and large trees screened many a promising view, but at last by dint of searching I found the setting shown in Plate VII.

There is a legend connected with Lichfield for the truth of which I cannot vouch, and yet the facts seem to bear it out. In the right center of the picture of this cathedral is a large house obscuring to some extent an otherwise delightful view. The story goes that two sisters lived together in a residence overlooking the cathedral. Some unfortunate family difference having disturbed the tranquillity of the home, one sister departed and expressed her feelings by deliberately building this house with the idea of ruining the view. In this she was largely successful.

Now I have a confession to make which invoked artistic license. I do not think that anyone seeing the cathedral from the standpoint from which my sketch was made would realize the liberty I took. The house was three stories, I made it two. This is my only digression from absolute truth.

FINE VIEW—FROM POLICE STATION

Durham, one of the finest of all English cathedrals, presented no difficulties in finding a setting. The problem was rather one of choice. I arrived in Durham on a lovely summer's evening, and, having dined, set out on a tour of the city. At last I came on the view seen in Plate XI.

I was most anxious to work from my car, since in the event of sudden rain, not unknown in these islands, I could close the windows and continue to draw.

Unfortunately my choice of position was immediately outside the gates of the Durham Constabulary Headquarters. I approached the Inspector of Police, and was told that the place I had selected was out of the question, since forty police cars entered and left the gates during the day.

What to do, then? Below me was a steep hill; if I went forward the view was lost. However, the Inspector helpfully suggested that I should go to an inn close by and see what it afforded in the way of a window with a good view.

It was a happy thought and the proprietors were kindness itself. The innkeeper's wife lent me an excellent room with an even better view than the one I had found from the car.

HOW A DRY POINT IS MADE

It might be of interest if I digress here to give a brief description of the process by which a dry-point engraving is produced, since the originals from which the plates are made are dry points. Technically, the making of a dry point and an etching are two distinct processes, although the result, except to an expert eye, is very similar.

The first stage is, of course, to obtain the actual pencil drawing. In this case all the drawings are sketches made at the cathedrals. The drawing is then transferred to a copper plate by pressure, the plate having been previously coated with wax or grease. The result is an image of

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CANTERBURY: HEART OF THE CHURCH OF ENGLAND

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WINCHESTER: SHRINE OF ENGLAND'S EARLY MONARCHS

© National Geographic Society

-Norman Wilkinson-

BOSTON STUMP: 36 BELLS IN A CELEBRATED TOWER

© National Geographic Society

Norman Wilkinson

IONA: CHAPEL OF THE HEBRIDES

© National Geographic Society

-Norman Wilkinson-

ELY: LANDMARK OF THE FEN COUNTRY

© National Geographic Society

–Norman Wilkinson–

WELLS: VAST INVERTED ARCHES SUPPORT THE TOWER

© National Geographic Society

-Norman Wilkinson-

LICHFIELD: STUDY IN GOTHIC SYMMETRY

SALISBURY: 404-FOOT SPIRE, LOFTIEST IN ENGLAND

ST. PAUL'S: FAMED CATHEDRAL IN THE HEART OF LONDON

YORK MINSTER: STAINED GLASS AND MELLOW LIGHT

DURHAM: MASSIVE, ROMANTIC, NORMAN

© National Geographic Society

Norman Wilkinson

PETERBOROUGH: RESTING PLACE OF CATHERINE OF ARAGON

© National Geographic Society

—Norman Wilkinson—

WHITBY ABBEY: SILENT BENEDICTINE MEMORIAL

© National Geographic Society

GLOUCESTER: LOFTY, MASSIVE NORMAN PILLARS

NORWICH: NORMAN TOWER AND DECORATED SPIRE

© National Geographic Society

-Norman Wilkinson-

WESTMINSTER ABBEY: ROSE WINDOW IN SOUTH TRANSEPT

the drawing on the copper plate in reverse.

This image is then cut line by line with a steel or diamond point. When the whole plate has been cut, it is inked all over with a soft pad and the surplus ink is wiped off, leaving only the ink in the cut lines.

On the plate is laid a sheet of paper which has been thoroughly damped. Plate and paper are then passed through a heavy press, with the result that the whole of the inked area is transferred to the paper and appears as seen in the plates.

SALISBURY DELIGHTS THE ARTIST'S EYE

One of my easiest problems was Salisbury (Plate VIII). This cathedral stands on the edge of the city in an ideal setting from the standpoint of the artist. In the midst of open water meadows with the Wiltshire Avon flowing close beside, it rises serene and lovely.

One of Constable's finest pictures was painted here. It is true that an inhabitant of the city whom I questioned on arrival as to the best point of view from which to see the cathedral replied that I could not do better than to look at it from the place from which Whistler painted it. He had his artists mixed. Such is fame.

The drawings of interiors presented fewer difficulties. They were simply a matter of choosing one of a number of fine views and trying to give some interesting and characteristic feature, such as the inverted arch in the plate of Wells, or to suggest the interior, as at York Minster (Plates VI and X). I was disappointed at York on finding that the famous Five Sisters Window was completely hidden by scaffolding. Its priceless glass has now been removed as a war precaution.

I think Whitby gave me as much pleasure as any of the series (Plate XIII). My journey there from York was the loveliest drive imaginable—over the Yorkshire moors, mile upon mile of glorious undulating moorland untouched by the hand of man, cloud shadows and sun glints slowly moving across the landscape, and in the distance occasional glimpses of the faraway silver of the North Sea.

The abbey itself is perched high on a headland opposite the red-roofed town of Whitby. Here, as the dry point shows, I had little difficulty in selecting a good point of view. Founded in the seventh century, the abbey shows even in its ruined state the remains of a superb building. Only the shell now remains, but as you walk through the ruins its magnificence can be imagined. What a picture it must have presented and what a setting, high above the sea—too big a temptation, alas, for the Danish raiders who destroyed the original building in 867.

While sketching the abbey, I had a visit from a gypsy woman. She walked over from a caravan which stood on the far side of the field where I was working. She paid little attention to my drawing, but, evidently feeling lonely, just wished to talk.

When my work was completed, she invited me to come over to the caravan in which she and her husband and small boy lived. The interior was spotlessly clean, with polished brasses and a coal stove. We sat and talked for half an hour and no question of money was even hinted at.

On leaving, I knew that times were hard with them. Their sole means of livelihood was fortunetelling among the visitors to the abbey. The weather was bad and few visitors came. I had difficulty in persuading the gypsy woman to take a small present, and her assurances about my future were ample repayment.

I made a sketch of her and you may see her on the right of the abbey, a small figure with a bucket on her arm crossing to a near-by farm for water (Plate XIII).

THROUGH THE BYWAYS OF ENGLAND

As an artist I have had a most interesting life, possibly more active than many in my profession in that my work has taken me to many parts of the world—Iran, Spain, the West Indies, and up the Amazon, to name only a few. But of all the commissions that I have been called upon to undertake, none has given me more pleasure than the search for material in making this series of drawings for the Cathedrals of England. I drove myself, and my way led through most of this beautiful island.

If one takes to the quiet byways, it is quickly realized that rural England is far from spoiled. There are villages untouched by new housing, farms tucked away in quiet valleys, parklands and mellow country houses, a profusion of hedgerows, wild flowers, and an endless variety of bird life.

As one rounds a bend in the road, a beautiful tapering spire, grayish gold in the morning sun, appears far away, only to be lost behind the trees. Soon it is seen again, nearer, the delicate tracery of its

Photograph from Aerofilms, Ltd.

RIOT, FIRE, AND PURITAN ZEAL FAILED TO DIM THE GLORY OF NORWICH

More than 600 years ago, prior and citizens quarreled over tolls on roads. In a general melee part of the edifice was destroyed. Before the time of Cromwell, four damaging fires had occurred. The Puritans demolished windows, defaced monuments and stonework, destroyed the organ, and burned vestments and books. After each misfortune, the cathedral was repaired and restored (Plate XV). In the shadow of the lofty spire rests the body of Edith Cavell, World War nurse charged with espionage and executed by the Germans in Belgium in 1915.

stone showing more clearly, with jackdaws wheeling round its towers.

The jackdaw seems to be part of the atmosphere of a cathedral. For centuries these delightful birds have held almost a monopoly of nesting places. Without them one would feel something lacking; their cheerful chatter adds to the scene.

And now appear the red roofs of houses tucked up close to the cathedral, almost seeming to seek shelter beneath the great building that towers above them.

If one's approach happens to be on a still Sunday morning, the pealing of bells is heard far away, suggesting an atmosphere of peace it is difficult to describe.

Whatever may happen to posterity in its unceasing struggle, I believe that these monuments of man's faith will still stand, and the people of the dim future will look at these masterpieces in stone and marvel at the hands that fashioned them.

Members may obtain sets of enlarged reproductions of these 16 engravings of English Cathedrals, by Norman Wilkinson, from the National Geographic Society, Washington, D. C., at $2.00 the set in the United States and Possessions (elsewhere, $2.25) postpaid. Printed in gravure on paneled art paper, 11 by 14 inches, the reproductions are ideal for framing. They are available only in complete sets.

WHERE EARLY CHRISTIANS LIVED IN CONES OF ROCK

A Journey to Cappadocia in Turkey Where Strange Volcanic Pinnacles Are Honeycombed With Hermit Cells and Monasteries

By John D. Whiting

American Colony, Jerusalem

DEEP in the interior of Turkey, in ancient Cappadocia of the Bible, there stand today some of the strangest structures ever created by the combined hand of Nature and man.

Through the erosive action of wind and water upon volcanic rock, huge spectacular cones were carved and then through the centuries were hollowed out by the devout Christian inhabitants of the region to form hermitages and monasteries.

Twenty years ago the National Geographic Magazine first portrayed these remarkable honeycombed rocks with the aid of a notable series of photographs.* Now, in view of the development of modern color photography and the many changes which have taken place, even in isolated parts of the world, the Editor of The Geographic requested me to undertake a journey into central Asia Minor to study and record in color photographs the striking characteristics of the Cappadocian cones and the dwellers there.

Cappadocia, I knew, was a land where Christianity had won an early footing. Yet, even to one who has long resided in Bible lands, it was little more than a name, since the area lies 475 air-line miles north of Jerusalem. I remembered it chiefly as belonging to a string of New Testament geographical names long since altered by map makers—"Parthians, and Medes, and Elamites, and the dwellers in Mesopotamia, and in Judæa, and Cappadocia," among whom St. Peter made converts in the later years of his ministry (Acts 2:9-11).

Details of what we were to encounter on the trip to Cappadocia were obscure, since little or no advance information was obtainable. The Turkish consul in Jerusalem, however, proved most co-operative and provided us with a letter of introduction to the Vali (Governor) of the Cappadocian city of Kayseri. In fact, in the course of our journey we were treated with the utmost kindness and hospitality. From the highest Turkish official to the lowliest Anatolian farmer, all showed a genuine regard for the United States.

The Swedish nationality of Eric Matson, who accompanied the author to take the photographs, also proved an asset. Sweden, having had no part in the World War, had taken no hand in dismembering the old Turkish Empire, nor had it stood in the way of the upbuilding of the present New Turkey.

"Man Friday" as Chauffeur

The third member of our party was pleasant Juma'a el Warri, a native of Jerusalem and an excellent chauffeur-mechanic. His name, literally translated, is "Friday of the Rough Country" (rocky or stony), a fitting companion for a modern Robinson Crusoe, marooned forty days in a country almost all rock.

It was in the early autumn that we finally started—rather late for the north climate and the return trip through the passes of the Taurus (Toros Dağları). In all, our Ford carried us 3,110 miles.

We loaded up with spare axles, springs, and minor parts; and although most of the journey was over cruel tracks, all our spares, except tires, returned to Jerusalem unused. Our only casualty was a door handle.

The first morning was taken up in adjusting the load, and after a hasty lunch we started the run to Beyrouth in Syria (map, page 767).†

On the top of Mount Scopus, where Titus pitched his legionary camps for the destruction of Jerusalem in the year 70, were

* See "The Cone-Dwellers of Asia Minor," by J. R. Sitlington Sterrett, National Geographic Magazine, April, 1919.

† See also the National Geographic Society's Map of Bible Lands, a special supplement to The Magazine for December, 1938.

Photograph by Eric Matson

A TIGHT SQUEEZE ON A CAPPADOCIAN ROAD

To keep the fenders from scraping the rock walls the car body had to be pushed over as it rounded corners. The author's researches indicate that these roads were built by the Hittites millenniums ago. Fortunately, the roads are just wide enough to accommodate the modern motor car, except on curves.

rows of white-domed tents. Instead of an invading host, however, they sheltered a cosmopolitan but predominantly British gathering, watching the annual Palestine police sports. As we slackened our pace, Arabian camels, ridden by Bedouins, were doing an English "maypole" drill and an American "cakewalk." A diminutive white handkerchief waved from the crowds a farewell from Mrs. Whiting.

We sped by the legendary site of Nob where reposed the sword of Goliath, and where David and his famished outlaws satisfied their appetites with unlawful sacred bread (I Sam. 21:1-9).

THOUSANDS OF YEARS OF HISTORY IN A HALF-DAY RUN

For a stretch the modern road paralleled fragments of the Roman paved highway over which St. Paul as Saul of Tarsus started on his mission of persecution of the Christians (Acts 9:1-3).

From near-by Ramah we followed the steps of Hannah, who made her yearly pilgrimage to the Hebrew shrine, visiting with a gift her infant priest son, Samuel, at Shiloh, now called Seilun (I Sam. 2:19).

In due course we crossed Esdraelon, the battlefield of nations, where Lord Allenby, "Lord of Armageddon," gained his decisive victory.

Skirting Mount Carmel and its thousand valleys to Haifa, we headed up the coast to Acre. Its Crusader castle is now a British Mandate penitentiary, with an ultramodern death chamber in one of the oldest dungeons.

JONAH AND THE WHALE

Tyre (Sour), the mother of maritime commerce, we passed by between us and the sea. Then we drove through its ancient ally, Sidon (Saïda), and on to Beyrouth, the Levantine capital of the new Lebanon Republic.

All the long way to Cappadocia our route

was paved with history. As we rounded the Gulf of Alexandretta several days later, our road at one point was carved into a steep bank atop a precipice with a cosy little bay and narrow beach at its feet.

Here are ancient masonry-like square towers atop a protruding rock separated by a railroad cut. These are called "Jonah's pillars," and are, according to legend, the site where Jonah made the whale seasick (Jonah 2:10).

Soon now we penetrated the towering Taurus through the Cilician Gates, the Turkish mountain pass which in the ancient world formed the link between East and West.

Alexander the Great, fearing an ambushed enemy, led his armies through these Gates in 333 B. C., on his way to world conquest. Here passed Cyrus the Younger, Persian Prince, with his ten thousand Greeks in 401 B. C., hoping to gain for himself his brother's throne of Babylon.

Photograph by Eric Matson

ASSES AND OXEN ARE A MENACE TO MOTORISTS

Roads frequented by these solid-wheeled oxcarts and little donkeys, so practical to the small farmer, were a source of innumerable tire punctures. The animals are shod with large-headed hand-forged nails. One of the author's tires picked up twelve nails at one time.

It is not the triumphs of these great armies that have endured, any more than those of later generals who carved their deeds into the living rock, nor the march of the Christian armies on their way to Jerusalem. The only conqueror to pass these silent sentinels, whose influence has not faded, is Paul of Tarsus, going from Jerusalem, of the East, through Cilicia and Cappadocia to Derbe, in the West, and to the world at large (Acts 15:41; 16:1).

As we bumped along, the roads in places were crowded with men and pack horses, heavily loaded. We encountered only one cart and a couple of motorbuses. Between the pines grew smaller junipers, and in the valley beds huge plane trees.

Along the road from Adana we had encountered an occasional khan, or inn, a couple of police posts, from which police signaled us to proceed, and a long string of drinking fountains, both old and new, derelict or still spouting water from a stone

Photograph by John D. Whiting

EVERY DAY THIS MAÇAN GIRL CARRIES SPRING WATER TO HER CONE HOME

National costume in modern Turkey has disappeared and Western dress has been adopted. But in isolated sections, girls still tie their hair in sixteen braids, and wear baggy trousers in place of a skirt.

spout for the thirsty, and into a stone trough for the animals. These have all been erected as pious acts, with evidently no provision for keeping them in order (Matt. 10:42). Never have I seen so many.

MOUNT ARGAEUS, FATHER OF CONES

After we left Niğde our road took a steep descent to the wide, flat plateau dominated by the lone Erciyas Dağı, the Mount Argaeus of classic history. It is the highest mountain in Asia Minor, and perpetually snow-capped. The setting sun turned the white cap into a vivid pink, and the base of the mountain was bathed in transparent sapphire.

Mount Argaeus we were to pass often on our journeys back and forth among the cones of Cappadocia. It dominates the district for many miles, and had it not been for this extinct volcano and its outpouring of ash and lava there would be no Cappadocian cones. It was smoldering in Strabo's time (25 B. C.), but has, so far as we know, been inactive ever since (Plate II).

Shortly after striking this level plateau, we came upon two men with one gray and two black Slughi dogs (Persian gazelle-hounds), which had just caught a large hare. Darkness fell early, and in the twilight we could see many of these large hares dazzled by the lights of the car.

The road was so ill-defined that we lost our way and hit upon an oxcart track in which the solid-oak wheels had furrowed two long deep ruts in the soft volcanic rock. These fitted our Ford wheels exactly, but soon the grooves became so deep, and the ridge so high, that we could proceed no farther. The bark of dogs led us on foot to a village, where we got our bearings. How Friday ever got the car out of those ruts and turned around and back to the main road will ever be a mystery.

Bumping along in the darkness, we passed through İncesu, a town we were to see often during our wanderings. On our right all the while were the extensive swamps that encircle Mount Argaeus, and form an effective barrier between the road and mountain. To pass them the road strikes farther north than necessary, and then makes a sharp bend to the southeast on its run into Kayseri.

Drawn by Ralph E. McAleer

INTO THE HEART OF TURKEY THE AUTHOR JOURNEYED TO VISIT THE CONE DWELLERS

Driving along the Syrian coast northward from Jerusalem, he passed many historic spots mentioned in the Bible and places made famous by the Crusaders. Crossing the Taurus Mountains (Toros Dağları), he bumped and climbed over roads first built by the Hittites and, as he says, "not repaired since." Through the valley of the Halys River and in the shadow of Mount Argaeus he rambled through the "Coneland" of Cappadocia (inset on large scale).

As we rounded this corner, long rows of bright electric street lights and a large illuminated building gave the impression that we were coming to a modern metropolis, an important railroad junction, where we could find a comfortable, perhaps luxurious, hotel and a superb supper. We were hungry.

Upon our arrival, the great city vanished like a mirage. Kayseri is a modest town, chiefly of one-story buildings, with streets not too well paved. We later learned that the large building was the fine railroad station, and that the street lights connected the station with the town (page 778).

Kayseri, originally called Mazaca, was built upon the lower levels of Mount Argaeus, and was the capital of the kings of Cappadocia. Little of the ruins remains. Like a number of towns in the ancient Roman Empire that were named Caesarea in honor of the ruling monarch, this city is supposed to have been rechristened by Claudius, and to distinguish it from others was known as "Caesarea Mazaca."

Kayseri's geographic position has made it commercially important throughout the ages. It lay on the ancient trade route from Sinope (Sinop) to Babylon and the Euphrates; on the Persian "Royal Road" from Sardis to Susa (Shush), and on the Roman road from Ephesus to the East. Today, not only is it a center of the up-to-date railroads of Turkey, but an important link in the through rail journey from Cairo to London.

ANCIENT CITY MAKES FIGHTING PLANES

Kayseri is a city of contrasts. There are several splendid examples of Seljuk architecture, both madrasahs and tombs, fine old mosques, and an extensive medieval bazaar of extraordinary interest and preservation (unfortunately—we thought—now being destroyed to make way for modern streets). Here an up-to-date airplane factory turns out Turkish war planes (originally under the supervision of an American), and a huge mill, erected by Russian

engineers with Soviet looms and some American machinery, converts the native cotton into cloth.*

We found lodgings in the best native hotel. Early the following day we went to the police station to register, for in Turkey every police station is a potential boundary, and, while waiting for the proper authorities to arrive, strolled to a native restaurant for breakfast. Anyone wishing to taste a superb melon may go to Kayseri, and not be disappointed.

In Kayseri Friday found a Damascene barbershop and asked for time for a haircut. He parked the Ford while I went about the bazaars. I returned with four large fat hens, for which I had bargained in my few lame Turkish words. My purchase cost 40 cents, United States money. Friday was shaven and shorn, powdered and fleeced. The "beauty" had cost him, personally, 42 cents. This earned me the nickname of "Kayseri," a term synonymous with "bargainer," and a laugh on Friday.

With a little more ink on our passports, we bumped our way out to Talas, where we were most kindly received by a small band of American medical and educational workers, ably assisted by native Turks.

"CONELAND" BURSTS INTO VIEW

Daylight, as usual, saw us well on our way. As we slowly rose to the top of Topuz Dağ, a magnificent sight burst into view.

Before us spread out a vast expanse dotted with multihued sugar-loaf cones, some the size of an ordinary tent, others the height of lesser skyscrapers. It is said fifty thousand cones can be counted, and, whether this estimate is correct or not, the figure does not overestimate the impression. The Biblical reference to the Midianite tents being "as grasshoppers for multitude" seemed especially fitting (Judges 6:5).

The view was not only of magic form but also of vivid color. The crags, cliffs and cones varied from snow white to cream, tan, ocher, pink, red, and gray. The very atmosphere seemed steeped in brilliant hues.

I had come to Cappadocia expecting to find the color of these capped cones even more vivid than that of Petra, the rose-red city of rock in Trans-Jordan.† In reality there is little basis for comparison. Petra's sandstone has actually more varied colors and deeper shades than this solidified volcanic ash.

EROSION KEEPS CONES BRIGHT

The Petra rock, however, where exposed to storms, has to a large extent weathered; the vivid colors have been dulled by a sort of gray patina. Here, erosion is unceasing, caused by wind, weather, and the constant blowing about of the coarse grit, so that all rock surfaces have the appearance of being continually sandpapered into eternal freshness.

As we explored this cone country during the ensuing weeks, other points of contrast were patent. Petra's monuments are chiefly large and imposing façades, with lesser and undecorated interiors, mostly the tombs of the dead. In Cappadocia the exteriors are the work of Nature, almost untouched by man, while the interiors are vast and complicated, and some are highly decorated. These consist largely of churches, chapels, monasteries, nunneries, and hermitages—all the abodes of the living, with, however, adequate and honorable provision for the dead.

Even for one who knows little of geology the rough outlines of the life story of this fascinating district unravel as he journeys about among the cones. To realize what this terrain was like in pre-cone days, one has but to look across the Halys River. There the hills are rolling and undulating, and composed of white fresh-water limestone.

HOW THIS WONDERLAND WAS FORMED

In the dim past the valley of the Halys River, which here cuts straight across the map, making a rather definite north boundary to the cone district, was deep and wide. In a series of Argaeus eruptions this valley on the south side of the river was filled up with volcanic ash hundreds of feet deep, sometimes with an upper thin layer of lava or pumice.

From the top of the crater the débris of these volcanic eruptions reached a distance of forty miles or more. In the process of cooling this volcanic mass cracked. Winter rains and melting snows found their way to the mother river by means of these seams through the mass of obstruction, so rudely thrown down by Argaeus.

* See "The Transformation of Turkey," by Douglas Chandler, NATIONAL GEOGRAPHIC MAGAZINE, January, 1939.

† See "Petra, Ancient Caravan Stronghold," by John D. Whiting, NATIONAL GEOGRAPHIC MAGAZINE, February, 1935.

MULTICOLORED CONES OF CAPPADOCIA

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Autochrome Lumière by Eric Matson

WHEN CAPS ARE DOFFED, CONES BECOME BALD AND SOON WASTE AWAY

Often set at rakish angles, the dark lava blocks protect the soft mound beneath, preventing it from eroding. Exposed sides are sculptured by rains and streams and polished by wind-blown sand. The masklike mound at right has lost its covering and is rapidly disintegrating. Like human moles, hermits tunneled and gouged living quarters in many of the cones. This fantastic area, roughly triangular, lies about 150 miles north of the Gulf of Alexandretta in the isolated heart of Turkey.

© National Geographic Society

Finlay by Eric Matson

HOARY MOUNT ARGAEUS STANDS SENTRY OVER ITS STRANGE BROOD OF CONICAL CHILDREN, BORN OF ANCIENT ERUPTIONS

In the dim past, when this volcano was active, it covered the valley of the Halys River with alternating layers of ash and lava. As the thick mass cooled, it cracked. Winter rains and snows widened the seams into deep gullies and chasms, and wore down the heights.

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Finlay by Eric Matson

CELLS AND COTES HOLLOWED BY MAN HONEYCOMB ROCK TERRACES IN SOĞANLI GORGE

Early Christian monks and hermits carved their homes in the rocks of this wild and forbidding region. The smaller openings, at right, are dovecotes. Near here the author found a huge block of rock that had rolled down into the valley. Lying right side up, it contained a complete and undisturbed anchorite cell, suggesting a small stone cottage.

© National Geographic Society Autochrome Lumière by Eric Matson

A FORTIFIED SKYSCRAPER IS THIS CAPPADOCIAN CHURCH AND MONASTERY

Heavy wooden doors and locks today bar tunnel entrances to the castlelike rock with its hollowed-out sanctuary and smaller compartments. Here early Christians sought seclusion from the world in carved retreats and a flourishing monastic community grew up between the fifth and tenth centuries. Rope ladders and toe holes in the cone faces were often the only stairways.

Finlay by Eric Matson

PERHAPS ST. HIERON ESCAPED HIS PURSUERS IN ONE OF THESE CAVERNS

The Acts of St. Hieron, a sixth to seventh century document, relate how the saint, then a vinedresser, escaped from invading soldiers here at Maçan by taking refuge in an elevated cell in his vineyard.

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NEVER A ROSE BLOOMS IN CAPPADOCIA'S ROSE VALLEY

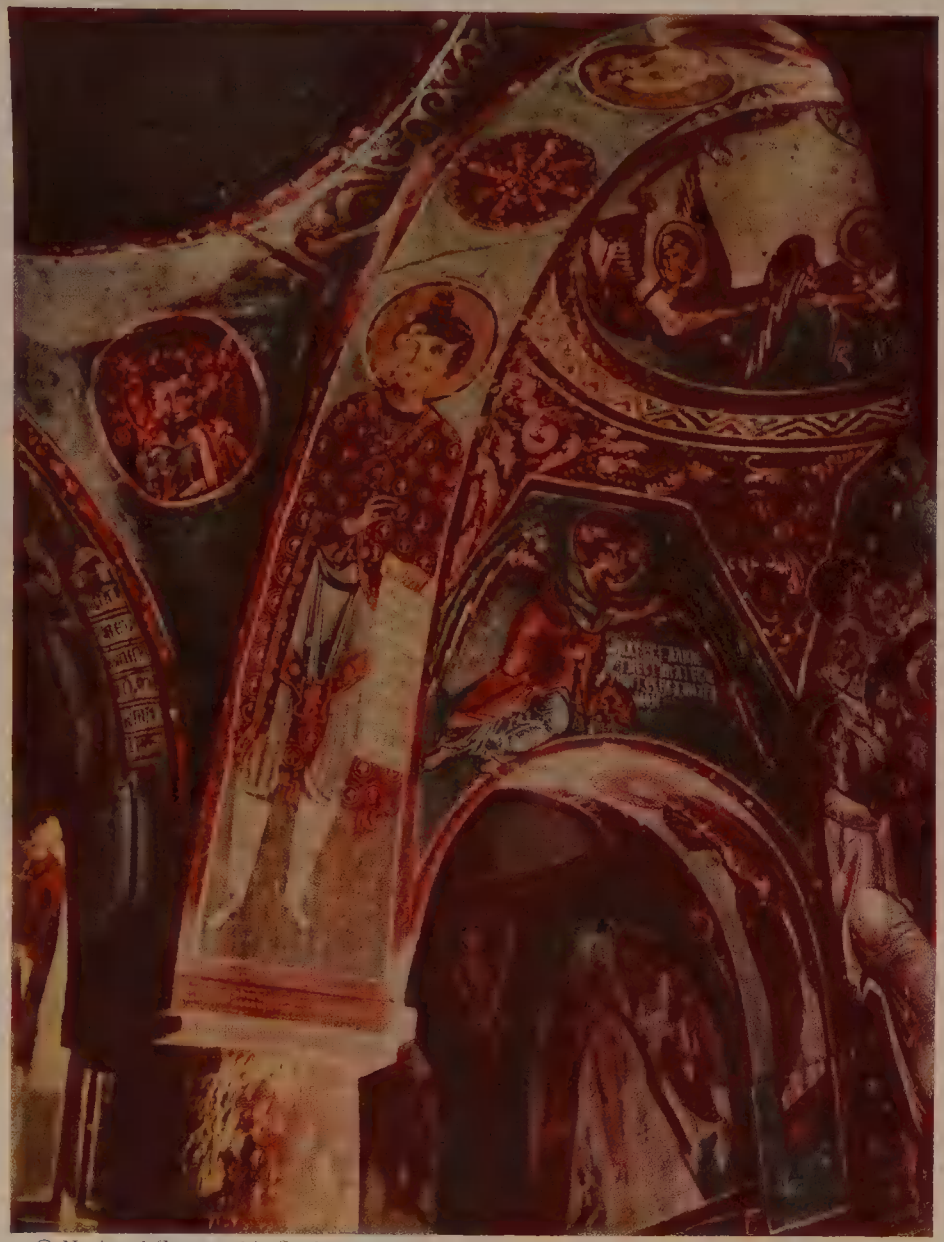
Colorful pink of the tuff gives Güllü Dere its name. Apricot orchards exist among scattered cones.

© National Geographic Society

Finlay by Eric Matson

FLAT-ROOFED HOUSES OF MAÇAN, ONCE AN EARLY CHRISTIAN BISHOPRIC, NESTLE AMONG WEIRD CONES

Built of compact tuff, many of these modern homes have arched porches or covered courts, for coolness in scorching summer months. Spacious living rooms, hewn out of the cliffs behind, are warm in winter, when the temperature falls below zero. Hollowed cones are used as storage rooms or aviaries. Dark caps cover each one.



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DANIEL FORETELLS THE KINGDOM OF GOD

Ten centuries ago an artistic monk here portrayed the prophet in Persian church brocades. The scroll reads: "And in the days of these kings shall the God of heaven set up a kingdom, which shall never be destroyed" (Daniel 2:44). The angel at right proclaims: "Ye men of Galilee, why stand ye gazing up into heaven?" (Acts 1:11).

Finlays by Eric Matson

A CAPPADOCIAN CONCEPT OF CHRIST'S BETRAYAL

Judas has just kissed his Lord in Gethsemane (Luke 22: 47-52). One of the "captains of the temple" stands at left, small sword uplifted. St. Peter, next to him, is about to sever an ear from Malchus, servant of the high priest. Nearly a thousand years have elapsed since Christians worshiped in frescoed Analipsis Church (Plate VIII).

Autochrome Lumière by Eric Matson

TIME AND MAN HAVE MARRED THIS CRUCIFIXION SCENE AT GÖREME

Beneath the right arm of the figure of Christ stand Mary and the women bearing ointments. Opposite are John, the "beloved disciple," and a centurion. Two miniature soldiers are on guard at the base of the cross. Above rise the darkened sun and the moon.

© National Geographic Society

Finlay by Eric Matson

"THEY PRESENTED UNTO HIM GIFTS; GOLD, AND FRANKINCENSE, AND MYRRH"

This old fresco in the Analipsis Church depicts the coming of the "three wise men from the East" (Matthew 2:11) to worship the Babe in the manger. Over the first gift bearer gleams the star of Bethlehem.

The cracks, in the course of untold years, widened out into deep gullies and deeper chasms, running into and at right angles with the river. Into these in turn ran smaller and smaller winter torrent streams, forming a sort of checkerboard; but since Nature loves curves, the upstanding cones were the final result.

DRUNKEN SENTINELS, WITH CAPS AT TIPSY ANGLES

Many of these cones have so-called caps atop them, a layer of protruding and protecting rock that has hindered quicker erosion (Plate I). The caps, often drunkenly askew, are mostly dark-colored, and many observers have supposed them to be of the black basalt rock that is so hard and time-resisting.

The fact is that we noticed no basalt beyond Topuz Dağ, which geologists tell me is the main stream of the lava flow, and the caps that we were able to examine were strangely of a light pumice that has a dark weathered surface. Though comparatively soft, it seems to resist erosion better than the harder and more solid-appearing tuff, a stone formed from volcanic ash.

In this strange land—we should more correctly call it "strange rock"—the plateau ends in precipitous cliffs. There are hilltops with natural rock castles surrounded by thickly clustered cones like a hen and chickens; there are deep narrow cuts with fantastic sides, and semi-detached cones.

There are wide expanses of cones, thickly placed cones of regular form, like the camp of a vast army; and again, in the broadening of the valley toward the river, there may be a lone giant cone, still cap-protected, while thousands upon thousands of its neighbors, uncapped, have decomposed into miles of flat fields.

This cone district makes an almost perfect equilateral triangle, each side measuring practically forty miles, with the points at Develi, Kayseri, and Arapsun (p. 767).

Our perch atop Topuz Dağ, where we first saw all "this geological fantasy," was practically in the center of this triangle.

The road down into Ürgüp was steep, full of short hairpin bends, and rough. Before going into the town we forded a stream and turned to the left up the valley to visit our first cone.

Though not at all symmetrical, this cone was large enough so that a gristmill had been built at its base with six stories of rooms above. A tunnel had been cut through the base to carry the river water to the mill.

As in so many of the cones, the chambers had been converted into pigeon houses, so that it was impossible for us to explore them; nor was this necessary, for many better preserved ones were later available.

Just across the valley rises a huge rock terrace, semi-detached from the highland behind it, and around it huddles the town of Ürgüp. The houses are built of nature-tinted fine-grain tuff, some with pillared, arched, and carved fronts. Instead of making their cellars under the homes, the people carved them into the solid volcanic rock wall back of the house (Plate XII).

Throughout the cone country there is no such thing as soil as we know it. All the cultivated valleys are deep in decomposed volcanic pumice and tuff. Here the apricot is native, vines are plentiful, and the grapes are renowned in the adjacent markets. Between the vines, melons, tomatoes, and various vegetables are grown.

Thousands upon thousands of the ancient excavated chambers and churches have been turned into pigeon houses (p. 802). The birds are not eaten; they are looked upon with almost religious awe, for without them mankind could not exist in the region. Once a year the guano is collected, and with it fields of almost pure sand are enriched into productiveness.

EARLY CONE DWELLERS CHRISTIANS, NOT CAVE MEN

From an article I had read on these parts before starting, I had been led to believe that we were to visit the dwellings and remains of a primitive people—cave men who craved isolation, whose basic ideas of society were quite opposed to ours; in short, that the present inhabitants still lived as in the Stone Age.

This interpretation we found to be contrary to facts as they revealed themselves to us. In all our wanderings we looked in vain for any remains or indications of primitive man. Such people may have existed. If they did, later man has obliterated all traces.

The earliest object we saw was a cone in Maçan with a definitely classical monument cut in its top reaches. We were unable to visit the interior; it seems to have been a tomb.

The majority of the antiquities date

Photograph by Eric Matson

KAYSERI HAS BEEN A CROSSROADS OF TRADE FROM ROMAN TIMES TO THE PRESENT

This city, nestling against the bosom of the twin mountain Ali Dağ, is an important junction on the London to Cairo railway. In ancient times caravan routes from Babylon to Sinop, on the Black Sea, and from Ephesus, on the Aegean, to the East met here. Today a Turkish airplane factory and a Russian-built cotton mill are located in the city (pages 767-8).

Photograph by John D. Whiting

MANY HANDS MADE LIGHT WORK OF PULLING THE CAR "OFF THE ROCKS"

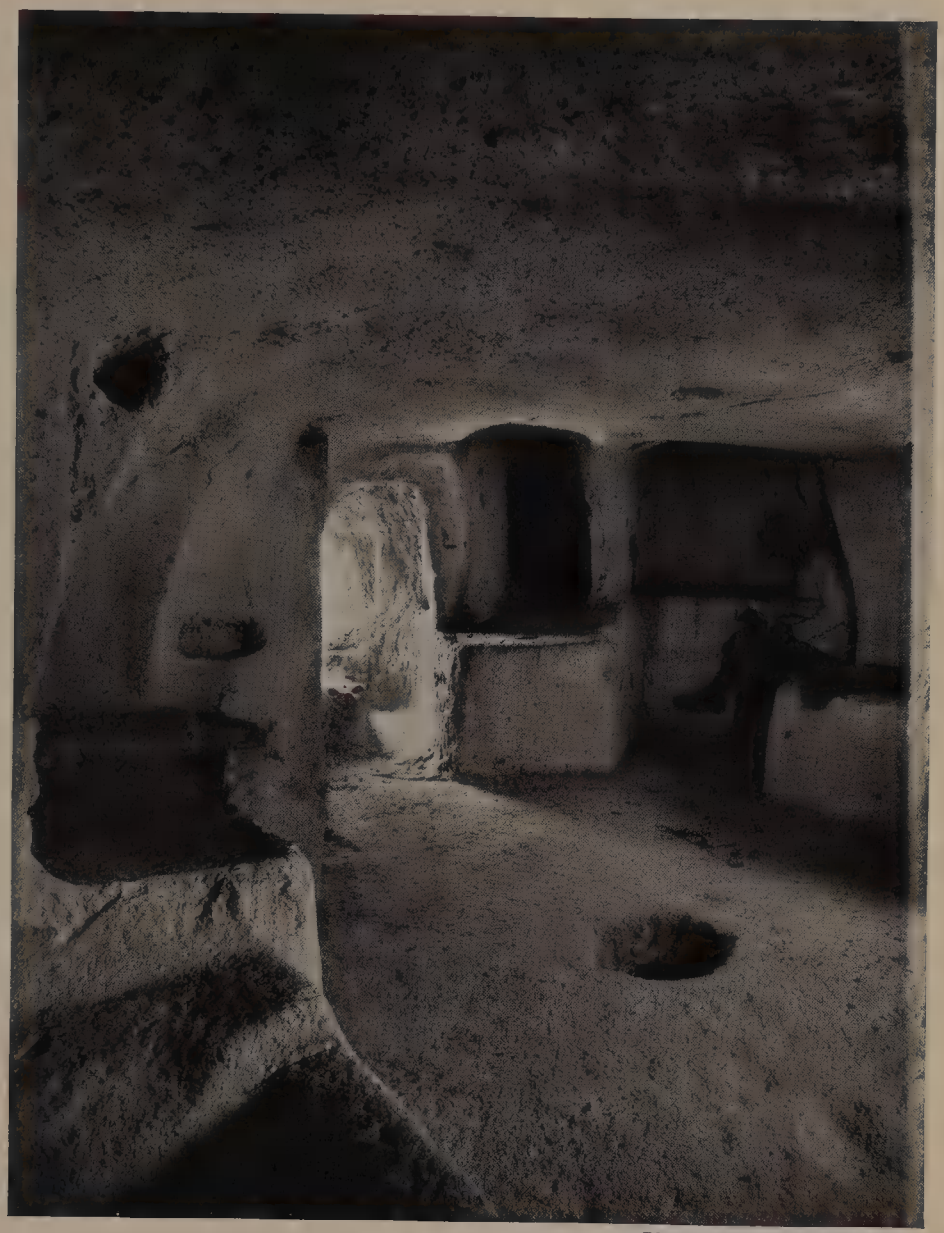
Here the automobile has straddled a rock which raised its rear wheels clear of the road. A passing caravan of forty men and women, with laden mules and donkeys, kindly lifted it bodily off the pinnacle.

from the earliest Christian period and appear to have reached a peak between the 10th and 12th centuries.

We probably do not err if we picture the early inhabitants living under three very different classifications.

First, there were the villages or towns, much as they are today, of which Ürgüp, Üçhisar, and Ortahisar, or even Talas, would be representative examples. Houses were built mostly against rock cliffs and around huge cones, which were excavated to form storerooms on the same level as the house.

It would be just as erroneous to call these dwellers, both ancient and present-day, "troglodytes" as to say that a hurricane-devastated or a burned-down American village had been inhabited by cellar dwellers.



Photograph by Eric Matson

THIS ROCK CELL WOULD BE AN IDEAL BOMB-PROOF SHELTER

Here lived a recluse and his disciple. Their comfortable cell, dug in a cone at Zilve, is completely furnished in stone. Carved from the rock at the left is a couch (head showing in lower left corner) and above it a second bed with a stone bolster, bedside table, and small cupboard in a niche. Next to the window is a closet and to the right of it an altar with three painted red crosses on the wall. The man sits on the cookstove ledge, equipped with a fire pot and a fuel box beneath.

In the second classification are the rock-cut convents where early Christians sought seclusion and safety, not as primitive man, who feared his neighbors and his own kind, but from a sense of desire to get away from the life of the world.

Far from being uncivilized and ignorant, these early desert fathers were often the leaders in the arts and letters, and swayed the destinies considerably. Basil the Great, a native of Caesarea, better known as St. Basil, was an organizer and exponent of the monastic life as opposed to that of the anchorite (religious recluse).

In the third classification are the solitary abodes of the hermits, cut into single cones, with chapel and cell for the exclusive use of a single anchorite, sometimes with a lone disciple (above). These disciples they looked upon as spiritual sons, probably copying St. Paul and Timothy (I Tim. 1:2 and 18; II Tim. 1:2; 2:1). Some of these hermitages were isolated. In other places they were in small groups

Photograph by Eric Matson

THROUGH A VALLEY GUARDED BY TIPSY CONE SENTINELS WINDS THE ROAD FROM ÜRGÜP TO NEVŞEHIR

Plodding along the highway beneath the rock walls of the plateau, farmers bring their produce to market. One of the donkeys is laden with grapes, the other two with sacks of tree leaves to be used as fodder.

Photograph by Eric Matson

TO THE AUTHOR AND HIS PARTY THIS CONE GATEWAY SEEMED A TRIUMPHAL ARCH—WELL-NIGH IMPASSABLE ROADS WERE CONQUERED

Crawling through the arch is the first motor car to traverse the ancient oxcart road to Soğanlıdere, deeply worn in the rock bed. Undoubtedly, the cone originally contained a hermit cell which was enlarged to allow the road to pass through (page 801).

USING CAR FOR TRIPOD, MR. MATSON PHOTOGRAPHS A CELL CONVERTED TO A MILL

In this lone cone, at Çavuşini, once probably an anchorite's abode, a stone disk is turned by a blindfolded horse or mule. Whole wheat is boiled and dried, then dampened and crushed under the millstone. Hulls come off readily and are separated by winnowing. Cooked with a stew of vegetables and meat, the palatable grit takes the place of potatoes or rice.

Photographs by Eric Matson

ENTRANCES TO MANY MONASTERIES WERE CLOSED WITH ROLLING STONES

Light in this cell comes in by two large windows, back of the camera, cut through a precipitous wall of a canyon. To enter, one must crawl through the small tunnel, which is longer than it looks. The disk, now prostrate, was rolled in a slot to close the crawlway.

Photograph from John D. Whiting

A TEA AND COFFEE SHOP IN ÜRGÜP

Weak tea, served with large lumps of native sugar, replaces the age-famed, strong Turkish coffee. Eric Matson, in lambskin coat, and the author, right, often stopped here for meals. On the low table set in the street the innkeeper piled dishes of grapes, pickled olives, goat milk cheese, sheep butter, and whole wheat bread. Dr. Fevsi Osman, the town schoolmaster (drinking a tiny cup of coffee), is one of a group of Turks who have forsaken their native cities and comforts to go into isolated villages to educate and enlighten the new generation.

of cones; or, again, clustered about the vicinity of a monastery.

ROCK-CUT CELLS LIGHT AND AIRY

The majority of these cells, chapels, and other necessary chambers are elevated, light, and airy, as we learned from experience when we passed the desert nights in them. Although they have now been converted to a large extent into pigeon houses, in the villages such as Maçan they are used for storerooms, stables, and so on. In California, Florida, or Connecticut, they would be at a premium for artist colonies or studios.

We estimated that 30,000 to 40,000 priests, anchorites, and ecclesiastical personages must have lived here at one period, quite apart from the town dwellers, who did not boast a life of celibacy. This figure is a guess, and may be far from the mark; it probably is conservative.

I could imagine vividly the vanished hermits, because in my boyhood I had seen their like, not far from Jericho.

On the face of a cliff, cells, probably of great age, were then still inhabited by anchorites. Here traditionally was the place where Elijah fled the wrath of Jezebel, and was fed by the ravens and drank from the waters of the brook (I Kings 17:4-6).

As we picnicked upon some small ledge, scanning the towering rock walls, our vigil often would be rewarded by seeing some venerable anchorite let down a rope ladder

Photograph by Eric Matson

LIKE HUMAN MOLES, PRIESTS AND HERMITS BURROWED INTO THESE CONES TO MAKE LIGHT AND AIRY HOMES

How "Coneland" was formed is clearly illustrated. The gently rolling plateau (left), covered with vineyards and orchards, is deeply gouged by river fingers (foreground and right background). In the distance is the castlelike town of Üçhisar with houses and caves nestling at its feet like chicks around their mother.

Photograph by Eric Matson

LIKE A VAST OPEN OPERA HOUSE, ÇAVUŞINI CLINGS TO ITS NATURAL AMPHITHEATER OF ROCK

High up in the cliffs, but easily accessible by ascending paths and step streets, is a large church. The rock pillar, upper center, is its porch or narthex. The church's architecture suggests Syrian basilicas. During the author's visit it was full of winter stores, farm products, and big stacks of straw used as animal feed. Tons of black raisins were piled on the floor and long ropes of fresh grapes hung from the wall or were spread on beds of thorn bushes which serve as fuel.

Photograph by Eric Matson

AN EVENING PASTORAL IN CONELAND WHERE RAISING OF GOATS AND SHEEP IS A MAJOR INDUSTRY

Photograph by John D. Whiting

EACH FARMER MUST BE HIS OWN BUTCHER AND GROCER

Meat hangs on the walls of this home, half cave and half stone construction, in Çavuşini. On the roof, thorn brooms and cattle feed are stacked. Grain and grape clusters are put away in the cone storage chambers, which are warm and dry. Clothing is cut from homespun wool.

Photograph by Eric Matson

ONE-TIME MONASTIC CELL IS FARMER'S CASTLE NOW

Outside in the cliff stable a sheep and goat are tethered to a rock manger. This is the spotless room where the "lord of the castle" lives. Delicious ripening melons hang from the ceiling. Bedding and bolsters are stored in the alcove by day and spread on the rugs at night.

Photograph by Eric Matson

THE CAP OF THIS BIG CONE, CARVED AND PAINTED, REPRESENTS A CHURCH DOME

One of the largest mounds in the district, Bel Kilise contains an entire monastery with about ten floor levels, all entered from the steep slope. The upper apartments were reserved for the church. Its top is decorated to represent a masonry cupola of colored marble. This cone and two others of the group are the only ones which have such adornments.

Photograph by John D. Whiting

NO FEAR OF RACE SUICIDE IN ZILVE

The author had climbed a fig tree to get a comprehensive view of a cone home. To his surprise he looked down into this family gathering. The women had just time to pull the veils over their faces before the shutter clicked, while the children stared in astonishment.

from a tiny aperture, descend to the monastery church for prayers, get a week's ration of black bread and perhaps olives, oil, and raisins or dried figs, and climb back up to his cell for another week of isolation.

One of the many recluses, his cave situated behind a narrow ledge on a sky-scraping cliff, was of special interest. Daily he descended on his rope ladder, scraped from the valley a little soil, and with the burden well strapped to his back, climbed the sixty or more ladder rungs.

By dint of such strenuous efforts he finally deposited enough earth to make a tiny hanging garden. Here he planted some onions, radishes, and fennel with which to flavor his scant morsel of black bread. From a small rock-cut cistern, fed by the winter rains through runnels, this strange gardener sparingly watered his bed of herbs.

CONES, LIKE HUGE PROJECTILES, POINT SKYWARD

Golkundra is an uninhabited Cappadocian valley lying under the rock walls of the upper plateau to the left of the track between Göreme and Maçan. A more interesting and picturesque example of Nature's handicraft is hard to imagine. The cones here are large and round, with straight sides and a pointed top; they look like big projectiles stacked ready to be fired from the guns of giants. Between them the small fields and ground patches are planted with vines and vegetables.

All along the plateau terraces is a mass of detached and semidetached cones in the process of being formed by Nature's forces. As the lowest cones melt away and flatten out, the nearer ones are carved apart, the bowels of the plateau potentially holding myriads of unborn cones that will not see the light of day for millenniums to come.

Contemplating the view, one is staggered by the thought of the time that has been required by Nature to form this fantasy. Still, comparatively, all is young. Hundreds of feet deep Argaeus deposited its volcanic masses in a valley bed of white fresh-water limestone, which geologists name Pliocene and tell us belongs to a fairly young period. We found traces of this limestone base rock and brought back

Photograph by Eric Matson

FRESCOES IN THIS BARREL DOME ARE MORE THAN A THOUSAND YEARS OLD

Wall paintings in Tokali Kilise, some badly mutilated, were probably done in the 8th and 9th centuries A.D. The priest artist, named Constantine, depicted scenes in the life of Christ. Under the plaster, early geometric designs and crosses, painted directly on the rock, are seen. A large cross, cut in relief, divides the upper wall into four fields. Eight saints are portrayed in a row. Above, to the left, is "The Journey to Bethlehem," with Joseph leading an ass on which Mary is riding. Before them a cone is portrayed. The upper right-hand picture shows an angel appearing to Joseph in a dream (Matt. 1:20). The frescoes over the pillars are of the following, left to right: Angel appears to John the Baptist; Jesus meets John in the desert; baptism of Jesus in the Jordan; temptations of Jesus; Matthew at receipt of custom; disciple fishermen on the Sea of Galilee (two boats); and marriage feast in Cana of Galilee.

bits so that experts could help us reconstruct the picture.

The ridge of Kılıçlar is especially rich in Byzantine ruins. Historically they are also young, being about ten to eighteen hundred years old, while the archeology of Asia Minor goes back some five thousand years. Still, what we call "antiquities" in the United States would here smell fresh. It is all a matter of comparison.

Kılıçlar seemingly belonged to the monastic orders, with a fringe of anchorites. There are so many interesting remains here, from the tiny donkey manger to a superbly frescoed church, that the thought of trying to describe them brings to mind St. John's words—"the world itself could not contain the books that should be written" (John 21:25).

Here, excavated into a bank, is the largest room yet discovered, measuring 32 by 21 feet. Back of it is a stable, and in one side a rock-hewn stove to hold a huge monastic caldron. Of wine presses there are some splendid examples.

On the outskirts of Maçan, toward Üçhisar, the cones are peculiar in their fantastic shapes and tall formations, like fools' caps or petrified cypress trees. In their topmost reaches anchorites lived.

WHOLE MONASTERY IN A SINGLE ROCK

Near by are the large, perfectly shaped cones, with complete monasteries contained within a single shaft. The convents visited heretofore, as in Göreme and Kılıçlar, were cut into the faces of cliffs or into large piles of rock. Here we found them in cones of a perfect sugar-loaf form.

One cone has been cited as one of the most finely shaped extant. Into a terrace below its base a sizable church is cut, with pillars, domes, apses, and simple frescoes. Architecturally it reflects the best period of Byzantine art. In the base of the cone proper are the refectories, with wine press, kitchen, and so on, and then, accessible only by a single shaft, are several stories of monks' cells.

The back of the cone is devoted to the monastery cemetery. Here are rooms, not easy of access, with graves cut into the floors.

Near this cone is a kitchen with a well-defined stove and chimney cut in the rock, and a refectory, with twin tables placed at right angles. The natives of these parts still quarry their building stone by cutting away a huge block and detaching it from the rock by the use of wedges. It is then split and re-split into the sizes desired. It is no wonder that so many of these solid refectory tables, blocks of stone all but detached, have disappeared under the quarryman's sledge.

At Paşa Baca is a small clump of cones which are tall, slim, and irregular in shape, reminding one of a company of gray-robed monks with black cowls on their heads. Some of the cones had more than one cap. Most of these cones and the cliffs behind were hermit haunts. Two characteristic examples let us into the life and psychology of the early Christians "fleeing from the world."

The smaller of the two is a rather thick-set cone with a long slim neck and a large-brimmed cap. It was quite clearly the abode of a lone Stylite.

THE FIRST PILLAR HERMIT

The first Stylite, Simeon, the son of a peasant, was born about 390. At an early age he started the life of a hermit and later lived for some time on the top of a shaft of moderate height. Later he moved to others, higher still, the last one being about sixty feet in height. Here he passed the rest of his life, delivering sermons that attracted thousands of pilgrims and pupils.

Simeon founded the order of Stylites, or Pillar Hermits. After his death a magnificent cathedral and monastery were built around his pillar at Kalaat Saman. Today these are among the most noteworthy relics of northern Syria, being reached from Alep (Aleppo) or Antakya (Antioch).

The second cone we visited twice and we passed one night in it. In natural formation it is unusual, being one of two cones having three separate caps rising from three sturdy necks. Its interior, however, is its chief interest, for it seems to embody all orthodox hermit architecture.

Very near this hermit's cone is a low, sprawly one of white, softish volcanic ash. Into this a stable was cut. These ascetics and near-by cenobites (members of convent communities) must have kept an ass or mule to help till the vineyards, bring water to their homes, and, when they were feeble, to bear them to church or to market. Just beyond is another small cone, in which a wine press was cut and the wine stored.

Two typical homes we visited merit description. One, a squat cone of consider-

able girth, had several rooms cut on grand lines. Before these the inhabitants had built a four-arched cloister. Throughout these parts, as in Syria, the people live in shady and cool covered courts during hot summer days.

HOME IN A CONE

The living room was spacious. It had a rock divan running around three walls, and a fireplace, of the same type as might be seen in an American home, also was cut in the living rock, flue and all. In the winter months these long seats are overlaid with straw or wool mattresses, covered with Turkish rugs and backed with cushions. A carpet fits the floor space; a roaring fire makes the room cozy.

The adjoining rooms were for the "hareem," and delicacy forbade our asking to see them. In the upper story, reached by a worn outside staircase, were a couple of smaller rooms, each with a door and a couple of windows, rooms far too attractive for their present use as stores for food and fodder. This cone, located in a garden, has a huge silver-leafed poplar growing by it, and with its domed roof it has the appearance of an İstanbul mosque.

More romantic is the home we visited in the cliff within the gorge. One first enters a room level with the floor of the valley. It was used for saddlery, etc. From it opened up the stable for the larger farm animals—horses, mules, asses, or oxen, which these farmers needed or could afford. From here a flight of steps led to a terrace in a large hollow in the rock wall, like a domed open-sided court. A huge "rolling stone" could be rolled across the stairway.

Upon this terrace opened all the rooms of the house. Those to the left were storerooms and a stable, where a goat and a lamb, tied to a rock-hewn manger, were being stall-fattened. The middle rooms were for the hareem, and to the right was the male guest chamber.

The room was long and narrow, spread with hand-woven striped rugs; an alcove at the end was piled high with bedding and screened with a blanket in lieu of a curtain. In the night these were laid out on the floor (page 787).

The ceiling was hung full of ripening melons, like baubles on a Christmas tree. Along one wall was a narrow shelf with scalloped edge, all cut from the rock, on which were placed a row of copper, pewter-plated, and colorful crockery dishes.

Our host, a simple, large-hearted person, insisted that we pass the night with him. He first made us partake of his ripest melons, and, with another villager carrying a large rug and an earthen pitcher of their excellent spring water, accompanied us to the hermitage. He spread the rug for our comfort, gathered fuel, helped cook our supper, kept the teapot boiling, and, in the morning, refused any compensation.

The cones clustering about the mouth of the gorge at Zilve, and in another near-by district, give the effect of being a tangled mass of giant petrified cactus. From each cone-top protrudes one or more round shafts of very hard rust-colored volcanic rock, as if Argaeus had spewed forth countless numbers of spikes, clubs, and staves with its ashen bile.

Instead of being harder masses laid down in the eruption that created the cones, these protrusions originated as vent holes. This low spot must have been hot. After the eruption the imprisoned gases or steam shot up, leaving round, chimneylike shafts in the now hardening and cooling tuff.

Year in and year out the winter rains of Argaeus trickled in tiny streams across the lava-strewn hillsides, carrying iron in solution. This liquid, mixed with ash, sand, and so on, poured into these now-obsolete natural chimneys. The water percolated away, and a very hard concretion often remained.

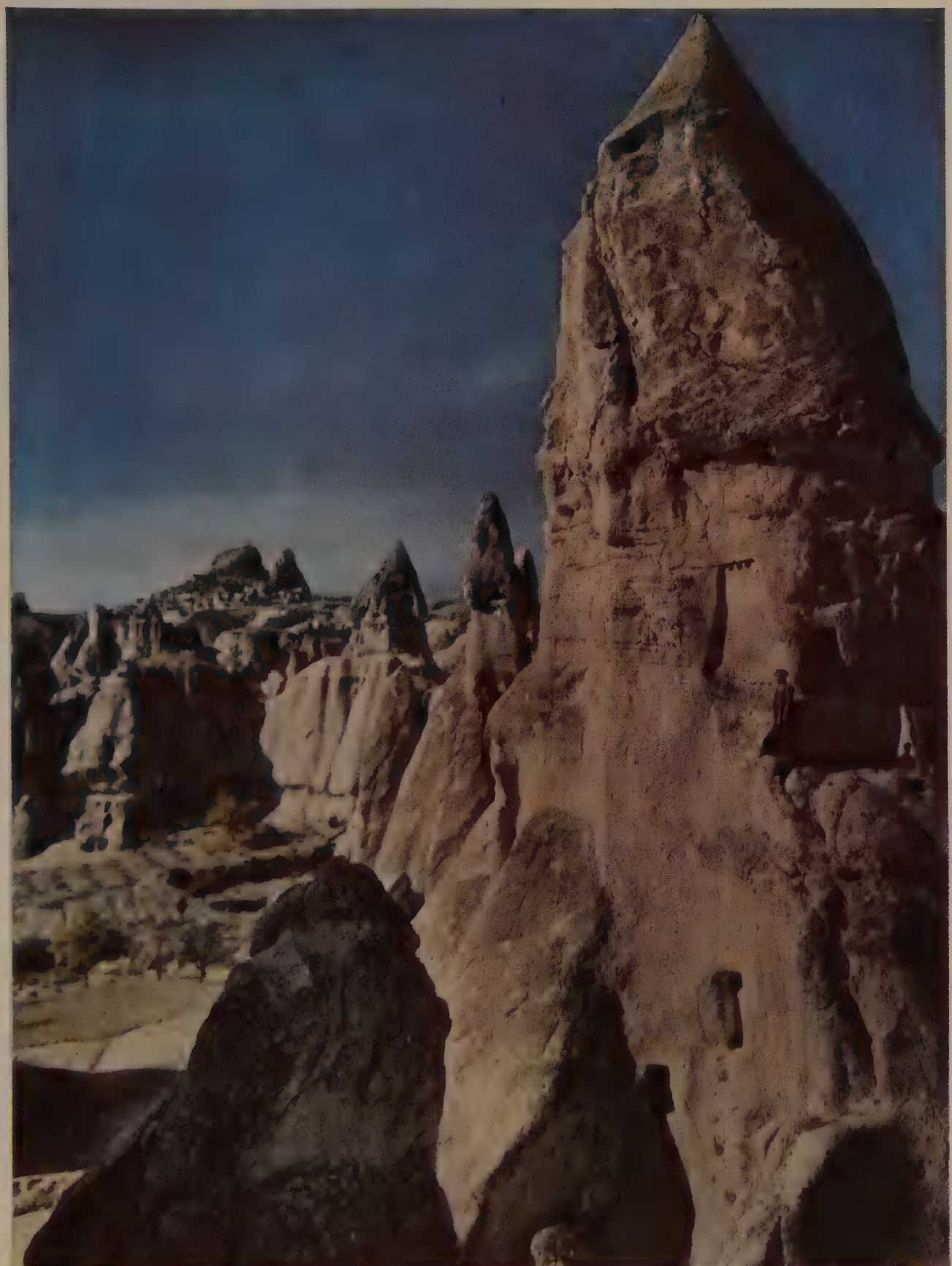
Century after century, these molds filled up and the surface eroded away. Finally there remained no cavity to fill, but erosion kept on its work, allowing these spikes to protrude farther and farther.

ROCKY ROAD TO ONION VALLEY

We had now fairly thoroughly covered all the northern part of the cone country. There were many more places worthy of a visit, but because winter was approaching, and snow might block the Taurus passes, we decided to content ourselves with a visit to Soğanlıdere, on the southern limits of the volcanic deposit. We were told by some informants that the way was very rocky, and only with difficulty could one ride a horse into this "Onion Valley," for so the village and gorge are called.

Others said that a good road had been lately made. Both stories had the essence of fact; neither was correct. We decided to

MULTICOLORED CONES OF CAPPADOCIA



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Finlay by Eric Matson

NO PLACE FOR THOSE WHO WALKED IN THEIR SLEEP

The man stands by a well-weathered cone, once used as a dwelling. Part of it has sloughed off, leaving one wall of a chamber exposed just to the left of his head. A path leads to the tunnel entrance, lower right. Around the village of Üçhisar, left background, rise other pinnacles honeycombed with caves and tunnels. The town is on the edge of the plateau and probably represents the ultimate height of the lava deposit.

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Autochrome Lumière by Eric Matson

CONSTANT EROSION KEEPS FRESH AND BRIGHT THE "MAKE-UP" OF CAPPADOCIA'S COLOSSAL STATUES

Nature's "sand blast," storm winds bearing coarse grit, gives the cones a polished appearance. Tints vary from snow white to cream, tan, pink, and gray.

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Autochrome Lumière by Eric Matson

WIND AND DRIVING RAIN WHIP LOFTY CONES INTO A JUMBLED MASS WHEN PROTECTIVE LAYERS OF HARD LAVA ARE MISSING

The author, taking notes in an apricot orchard, reached this "Grand Canyon" of Cappadocia with the photographer by driving along a track to the Halys River, then pushing the car up a lateral valley, and finally climbing on foot to this pink rock wall of the plateau.

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Finlay by Eric Matson

PIGEONS ROOST IN THE DESERTED CHAMBERS OF A ROCK MONASTERY

Doves monopolize thousands upon thousands of the old excavated chambers. They are not molested by the inhabitants, for were it not for the fertilizer which the pigeons supply, it would be impossible to cultivate gardens in the volcanic pumice and tuff. Once each year the guano is collected and spread over the fields. The modern town of Ürgüp clings to the rock terrace (background).

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Finlays by Eric Matson

DAVID'S ADVICE TO HIS SON, SOLOMON, INSCRIBED IN ELMALI KILISE SANCTUARY, LIVES THROUGH THE CENTURIES

"A wise son maketh a glad father: but a foolish son is the heaviness of his mother," reads the old king's scroll (Proverbs 10:1). "Hearken, O daughter, and consider, and incline thine ear; forget also thine own people," is the lad's response (Psalms 45: 10). Both wear brocaded robes and jeweled crowns. Right hands are raised in Byzantine church blessing. The thousand-year-old frescoes are only slightly defaced

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Autochrome Lumière by Eric Matson

ROPE LADDERS WERE ELEVATORS FOR THE HERMITS WHO OCCUPIED THESE PENTHOUSE APARTMENTS

In this natural rock garden in Maçan, tall poplars rival the slender cones in straightness and height. Apricot trees grow in the foreground.

© National Geographic Society

Finlay by Eric Matson

FROM HIS LOFTY CELL AN EARLY CENOBITE LOOKED OUT UPON THIS PANORAMA OF THE HALYS VALLEY

Remains of an extensive monastic institution dot the gorge, with many churches, chapels, and cells. Orchards and vineyards surround the town of Avanos (right background). Mountains rising beyond the valley are of limestone formation. They were out of reach of the eruptions of Mount Argaeus (Plate II).

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Finlay by Eric Matson

HONEYCOMBED LIKE A BEEHIVE, THIS HUGE ROCK HOUSED A SEVEN-STORY MONASTERY

The lowest level evidently served as stable and storerooms, the second as a chapel and refectory, and the third as the main church. Stooping through a low doorway, the author found a narrow shaft up which he scrambled with toes and fingers "like Santa Claus up a chimney." Reaching the upper cells, he came across a huge slab of stone which the monks could roll across the shaft's mouth to bar intruders. "As I climbed, I seemed to be like Jonah in the belly of some upstanding monster," he writes. "Now and then I got glimpses, through the openings, of distant and enticing landscapes, as if I were peeping through the buttonholes in the waistcoat of the giant. Finally, through the ceiling of the topmost cell, I emerged on the shoulder beside the headless neck towering above. Far below I saw Mr. Matson making this photograph."

try and would, if necessary, leave the car behind and ride animals or walk.

We left Talas early and took the main road toward the Taurus as far as Develi. A Public Works' road engineer could furnish no information about the road but took us to the gendarmerie post.

The mayor of Soğanlıdere happened to be in town and was most eager to take us to his village. He said we might drive up to his home in the Ford. This we actually did, but what a road! Ours was the first motor vehicle to penetrate a gorge where until lately no wheel had ever turned.

It happened that a few very large and old Circassian walnut trees had been growing here, and so valuable was this lumber in the world markets for veneering fine furniture that a road had been blasted out to make it possible for oxcarts to haul the logs to the nearest railroad station. On the way we met the empty carts with their solid oak wheels and sturdy oxen.

We drove through narrow lanes, along and across the tracks of the Taurus Express. Thorn hedges scratched the paint, and mud holes looked bottomless. Finally we reached the upgrade over a steep mountainside where the "new road" had been made. True, one could see where a bowlder had been blasted away here and there, but hundreds of rocks needed demolishing before motor driving would be practicable.

FRIDAY GETS COLD FEET

For the first and last time on the trip Friday got cold feet, and feared to risk a trial. A trifle of miscalculation, and the crankcase or back axle-housing would be smashed. Before we had left Jerusalem, no company would insure the car, not even Lloyd's of London; consequently, we had followed Friday's logic of "insuring with Allah."

It was now a case of making a trial, a wreck, or giving up the trip. There was no place or time to send for pack animals to carry our necessary equipment. We tried. So steep was the first bit that four had to push, and then the Ford only crawled. The oxen had hauled only empty carts up.

After negotiating this mountain barrier without accident, we struck in the next valley an ancient oxcart road, deeply worn into the rock bed. It probably once connected with the north. So narrow was it that in rounding corners we had to get out and push the car body over to keep the fenders from scraping on the rocks (p. 764).

The modern Soğanlıdere is a twin village. One part has a few homes built upon a terrace, a deep chasm below, and a high wall of rock above. We kept our car on this slope, and had to block the wheels to prevent its possibly dashing headlong into the abyss. It was the first car these people had seen. The other section of the village lives up the gorge in what were once monks' abodes.

To enter the town, we had to pass through an archway in a cone like an imposing triumphal arch (page 781).

16-STORY CLIFF APARTMENTS

Between the lower and upper villages is a deep connecting chasm with high precipitous tuff walls. Into the rock walls the early cenobites excavated apartments up to 16 stories high. These hundreds upon hundreds of cells have mostly been turned into pigeon houses; the villagers, having little land, sell the guano to more fertile districts and practically live upon this income.

As we passed up between these cliffs, the tops bespeckled with blue doves sunning themselves, the valley resounded with the songs of the male birds as they strutted around their complacent mates. To make the doves fly, the Turkish guides clapped and shouted vigorously in unison, bringing a flock of blue wings over the valley, reminding one of a cloud of locusts.

A VILLAGE MAYOR HOSPITABLE

We passed the night in the humble home of the mayor of this tiny village, who was an exceptionally genial host.

The house was built on a steep hillside; the family evidently lived in a row of semi-basement rooms. The foundations were thus laid for a much larger home; only one of the second-story rooms had as yet been erected. The people build here piecemeal, as circumstances dictate.

Tired from long tramping, crawling, and climbing, we were glad to get out of the evening cold. Around three sides of the room ran a continuous divan, covered, as well as the floor, with colorful Turkish rugs. In the center was an American airtight sheet-iron stove. Its warmth was welcome.

As we started to unpack some supper, our host and his son came in carrying a large tray, on it a dinner of beans and chicken, cooked much as we do pork and beans,

Photograph by John D. Whiting

CLOUDS OF DOVES OBSCURE THE SKY IN THE VALLEY OF SOĞANLIDERE

Each cell window has been blocked up, and tiny holes left just big enough for a dove to enter. Although there are countless windows, the birds pick the right entrance. Nesting holes have been dug in the cave walls and perches installed. Each year the cotes are visited and the guano collected to fertilize the orchards and vineyards (page 777).

with salad, bread, and other incidentals. Sitting cross-legged around the tray, we ended with the ceremonial Turkish coffee. The mayor's wife must have been a good cook. Possibly we were very hungry; still, I doubt that beans and chicken could be cooked better.

To indicate their welcome, the elders of the village came in to call. One was a venerable gentleman. Our host related how he had spent nine consecutive years in the army, serving through the World War, and had been raised to the rank of a non-commissioned officer. He had fought on all Turkish fronts, including Palestine and Sinai, and had not been ill a day, or wounded, through it all. Many and varied were the stories he narrated.

We had noticed a general interest in the national lottery for the benefit of the air-craft defense wing. One of these men drolly related a story, just as seriously as if it had been true, of a Turk who wished to get a divorce. Asked his reasons, he confessed to the judge that he had brought home some lottery tickets, had dreamed that he had won the million-pound prize, and that his wife now tormented him for not banking the check before he awoke.

AIR MATTRESSES AMUSE MAYOR

Our air mattresses so amused our host, who had insisted upon spreading beds for us, that he begged us in the morning not to deflate them before showing them to his women folk.

There was enough material in this area for weeks of research, but the year was getting old, and we had to press on before the roads were snow-blocked. We crossed the Taurus in a raging storm and it took a whole caravan to lift our car bodily over a washed-out place in the road (page 778). Winter was firmly closing the door to one of the earth's most remarkable regions, the cone country of Cappadocia.

ESTONIA: AT RUSSIA'S BALTIC GATE

War Often Has Ravaged This Little Nation Whose Identity Was Long Submerged in the Vast Sea of Russian Peoples

By Baroness Irina Ungern-Sternberg

RUSSIAN resurgence in the Baltic, with establishment of Soviet air and naval bases on Estonian territory, has made Estonia a headline word.

As a native of what is now Latvia and a longtime student of Estonia, I have been asked many questions.

"Where on earth *is* Estonia?" seems to be the commonest one.

"Well, it is south of the Gulf of Finland," I reply, "with the Gulf of Riga and the Baltic Sea on the west, and in the east along the Soviet frontier are Lake Peipsi, or Peipus, and swamps.

"It is an independent republic exceeding in size Switzerland, the Netherlands, Belgium, or Denmark, and has about the combined area of New Hampshire and Vermont."

"Oh, I see. Tell me, what language do they speak in Estonia?"

"Estonian, but also Russian and German. Until 1918 Estonia was one of the Baltic provinces of Russia."

Having gone this far, some of my questioners ask, "Won't you tell us all about it?"

Quite a large order when you consider that Estonia's history, or prehistory, dates back to 4000 B. C.!

POTATOES TO EAT AND DRINK

Personally, when I visit Estonia the question, "Do you know that fair land of potatoes and stone?" arises in my mind; it seems to me that nowhere have I seen so many rocks and such numerous fields with that nourishing fruit of the earth.

Estonia grows so many potatoes that there would be enough every year to supply each inhabitant with nearly a ton. But many are exported and others are drunk, in the form of potato schnapps. In one recent year a million gallons of pure alcohol were produced from Estonian potatoes.

Historians are of the opinion that several thousand years before the time of Christ, Estonians, Finns, and other peoples left the Ural Mountains between Europe and Asia for economic reasons. In those days their chief occupations were tilling the soil, cattle-raising, hunting and fishing.

STURDY FOLK, AKIN TO THE FINNS

The Estonians, a strong and healthy people, are thus of Finno-Ugric origin, akin to Finns and Hungarians. Their language is closely related to the Aryan family of tongues.

In physical appearance they vary widely. Whether I followed the city folk of Tallinn, studied the farmers of the countryside, or the students of Tartu, I could detect no definite cast of Estonian form or features.

Broad faces and high cheekbones are seen. But there are long, narrow faces, too. If one does form an impression of the Estonian type, the next dozen persons fail to conform.

Estonia's executives do seem to be of one type: square-faced, direct-eyed men of the kind who "could bite a nail in two," or say "No!" and stick to it.

The old Estonian religion comprised ancestor and Nature worship. This has been masterfully illustrated in the epic poem "Kalevipoeg," by F. R. Kreutzwald. Kalevipoeg is the Estonian Hercules and many are the sagas and legends told about this young giant, his father Kalev, his mother Linda, and his brothers. Kalevipoeg picked up rocks as we would pebbles, and oak trees in his way he simply pulled up by the roots.

GERMAN INVASION 7 CENTURIES AGO

The Estonians usually lived in villages headed by chiefs and elders. It was about the beginning of the 13th century when Estonia was successfully invaded. The German Knights of the Sword had conquered the Livs and the Letts who lived south of Estonia and from there they entered this land. Waldemar the Victorious of Denmark joined the Germans in 1219.

It was Waldemar who erected the castle of Reval, naming it for the local Revele tribe. The general population, however,

Photograph from Consulate General of Estonia

TALLINN'S TEMPLE TO MUSIC AND DRAMA IS THE CREAM-COLORED "ESTONIA"

Erected by popular subscription before independence was achieved, the building combines opera house and theater in one end, and a concert hall and ballroom in the other. Opera goers use their seat tickets for hat checks in the cloakrooms.

© Pasi from Three Lions

PRESIDENT KONSTANTIN PÄTS LIGHTS ESTONIA'S VICTORY FIRE

National independence is commemorated each year when victory over the Bolshevists at the close of the World War is celebrated. President Päts, who led the fight for freedom in 1917-19, has been at the head of the small Baltic State many times (page 816). On January 1, 1938, a new constitution, re-establishing the country as a republic, was proclaimed. Päts was elected president.

Drawn by Ralph E. McAleer

ONCE MORE ESTONIA BECOMES A FACTOR IN THE DESTINY OF THE BALTIC

The tiny country, about the size of New Hampshire and Vermont, occupies a strategic position on the Gulf of Finland. For seven centuries Estonia was ruled at various times by Denmark, German Knights of the Sword, Sweden, and Russia. After the World War, the small nation regained its long-lost independence. In September, 1939, Russia again obtained a foothold on the Baltic. Estonia permitted the Soviet to establish military and naval bases on the islands of Saare and Hiiu, and at Paldiski, near Tallinn. Similar concessions were made by Latvia and Lithuania, and the latter was permitted to regain its old capital, Wilno, which lies in conquered Polish territory.

called it "Taani-linn," which means "Danish castle." For this reason, when the Estonian Republic was created in 1918, Reval, the capital, was given the name Tallinn.

Long and hard were the fights, and victory often changed sides. Finally the German knights defeated the Estonians, and in 1346 Waldemar IV of Denmark sold his Estonian possessions to the Germans.

For two centuries comparative peace ensued, after which the country was swept by war with the Russians, Poles, and Swedes; it changed hands constantly. For a short time it was united under the scepter of Sigismund III, King of Sweden and Poland. More war and suffering followed until the 17th century, when King Gustavus Adolphus of Sweden conquered the country again.

Naturally the lot of the Estonian farmers was not an easy one. The German knights, who had become landowners and formed the ruling class, looked upon the natives more or less as their property. The Swedish kings intervened in favor of the suppressed population, however, and even now, when talking to the Estonians, you hear them frequently refer to this period as "the good old Swedish times."

Good times, however, have a way of coming to an end! The German nobility did not relish an interference with their rights, and, hoping to recover their lost privileges, encouraged the intervention of Poland and Russia. Although Charles XII of Sweden nobly defended Estonia, the country finally fell under Russian rule in 1710, so to remain until 1918.

FREEDOM SUNG IN FIERY VERSE

During all these years the Estonians never lost their national consciousness, and the desire for freedom was kept alive in their poems and songs.

Lydia Koidula, for one, so pictured in passionate verse the miserable state of her people that they clung to the idea of freedom when that blessing seemed beyond

Photograph by K. Akel

ESTONIANS VIE IN FINGER-WRESTLING AT PIRITA, A BEACH RESORT

Locking the little fingers of their right hands, competitors try to pull each other off their feet. All are guests at the newly developed watering place near Tallinn. Here restaurants and cabins line a mile-long strand.

Photograph by Herman de Wetter

"HORSE-AND-DROSHKY DAYS" SUIT ESTONIAN VILLAGERS

Store signs in Estonian indicate A. Schenk will sell the passing farmer paints and wallpaper; or chlorodont, a German toothpaste; or general merchandise. Over the arched doorway the billboard proclaims "rye-flour." At extreme right is a warehouse for timber, stone, and tar.

Photograph by K. Akel

TOES TWINKLE, SKIRTS SWISH, IN AN ESTONIAN FOLK DANCE

Gaily the old steps are revived at the giant Singing Festivals (page 834). The young dancers have 5,000 original Estonian tunes and folk plays from which to make up their program.

reach. One of her poems suggests a similar strain in Armenian verse in which a young girl reproaches a bird for singing so gaily when its freedom is a taunt to her miserable people, bowed under a foreign yoke.

The bright dream of liberty was fulfilled after the collapse of the Russian Empire and the overthrow of the Russian Provisional Government by the Bolshevists. But complete fulfillment had to await the end of German occupation and the successful culmination of the war of independence led by General Laidoner, the Estonian George Washington, against invading Soviet troops.

After thirteen months of terrific fighting, peace was signed in Tartu, Estonia's university town, on February 2, 1920. At last the time had come when this small country could develop, economically and politically.

Since those eventful days, nearly twenty years have gone by; and when I visited Estonia recently I was deeply impressed by what had been accomplished in such a comparatively short time.

I welcomed the opportunity of flying from Riga to Tallinn. This mode of transportation is certainly the most comfortable —at least in this part of Europe; I always feel at ease in the realm of clouds, both mentally and physically!

We were seated in soft leather armchairs in a well-ventilated plane and flew so low that it was possible to see toy farmers working in the fields. Our route lay along the shore of the Baltic Sea, and electric signs informed us of our specific whereabouts.

There was no annoying stop at the frontier between Latvia and Estonia, as is necessary when going by rail. At the border city of Walk (now called Valga), I've been told, unsuspecting foreigners used to get into trouble between trains when taking the station name for an injunction.

ONE SIDE OF MAIN STREET IN LATVIA, THE OTHER IN ESTONIA

The main street of Valga forms the dividing line between the two countries, and at one time if anybody crossed this thoroughfare unarmed with the necessary documents he risked arrest. I understand that the local inhabitants, however, have been given permits which make it possible for them to cross from one country to another without difficulty.

The inhabitants of Valga can thus do their shopping, visiting, and courting in all

Photograph by Herman de Wetter

DOWN FOUR CENTURIES, SEA GATE HAS ECHOED TO CART-HORSE HOOFBEATS

Tallinn's coat of arms, carved in a Gothic frame, bears the date 1529. The adjoining round tower, jocularly referred to as "Stout Margaret," was built even earlier. Before Estonia gained her freedom, the tower was used as a Russian prison.

sections of the city, irrespective of country. Again love has no frontiers, and a good housewife preferring to buy her lamb chops in Latvia and her vegetables in Estonia, or vice versa, is at liberty to do so.

From the plane I had a good bird's-eye view of Pärnu, one of Estonia's most fashionable summer resorts. When it belonged to the Russian Empire its thirty miles of avenues were virtual botanical gardens. They were badly damaged during the war, but now have been restored to their former glory, and even from above I was struck by the abundance of foliage, among which the houses were almost lost. I also had a good glimpse of Pärnu's principal attraction, its bathing shore.

Photograph by Stackelberg

FROM "PEEP-INTO-THE-KITCHEN," BURGHERS LEARNED HOUSEWIVES' COOKING SECRETS

"Kiek-in-de-Kök," townspeople call the fat, complacent-looking medieval watch tower. People climbed to its top, according to legend, so they could peer down into the kitchens of houses in Lower Town (page 811).

These waters may seem rather far north for swimming. Yet in summer the sea bathing is fine, and in the same latitude as Alaska's Valley of Ten Thousand Smokes, one can get nicely browned.

Of its mud baths, too, this little city is proud. At several points along the Estonian coast there are quantities of mud, composed of ancient plant remains and mineral matter, which is supposed to have curative properties. The smell of this medicinal mud is rather powerful, yet its popularity has been increasing yearly. Many patients come from foreign countries, particularly Sweden.

In an incredibly short time the electric sign ordered us in Russian to tie ourselves firmly to our seats, since we were landing in Tallinn. Obediently we carried out this command. For a few minutes before alighting our plane circled around like a bird of prey, since the automobile races were in full swing and to avoid smashing into an eager crowd it was necessary for our pilot to select his landing place most carefully. Not a car of the German, British, and Italian makes looked familiar to me.

Tallinn, the city of reveries and contradicting realities, was hidden in a dreamy

Photograph by K. Akel

MEDIEVAL "NIGHTCAP" TOWERS FLANK THE ENTRANCE TO VIRU STREET

Old houses stand side by side along the narrow avenue, once enclosed by Tallinn's walls. The present Town Hall, suggestive of a minaret, was built from a sketch supplied by Adam Olearius, who visited distant Persia in the seventeenth century, seeking a trade route for silk.

fog. Only here and there could I catch sight of a faint outline of its numerous towers.

A courteous English-speaking customs official inspected my baggage and inquired politely how much foreign money I had in my possession. I then hailed a taxi which swiftly bore me to my hotel.

IN ESTONIA A DOLLAR GOES FAR

Estonian money was a puzzle to me: The former Estonian marks had now been changed to krooni (crowns) equal in value to the Scandinavian unit of similar name, but some old Estonian paper marks were still in circulation, and although they bore the imposing figure "100" they represented only one kroon (about 25 American cents).

I found that a dollar went far in Estonia. For a large double room with bath I paid but $1.50, and for a delicious dinner with vodka included, 30 cents.

Next morning I set out to explore this city, which is like Peiping in that it is so different from anything else in the world. Walking across a large square to reach the city proper, I passed on my left a picturesque, clean marketplace, where women in gay kerchiefs were selling butter, eggs, vegetables, and pottery.

The narrow, winding cobblestone streets might have belonged to any medieval Danish or German town, yet in some subtle way they bore a Russian mark of the East. Above the old-fashioned horse-drawn cabs within the city walls, the houses look as if they leaned toward each other for support, so closely are they huddled together, and the overhanging balconies add an Italian Romeo and Juliet touch. And yet, strangely enough, automobiles, streetcars, and modern buildings do not seem out of place in this city of contrasts.

ONE-WAY SIDEWALKS IN TALLINN

I was impressed by the one-way pedestrian traffic on certain streets. Going toward the center of the city you keep to the right

Photograph by De Cou from Galloway

FIVE GILDED CUPOLAS TOP TALLINN'S FLAMBOYANT OLD RUSSIAN CATHEDRAL

Although the gilt on the domes has peeled considerably in recent years, the ornate red-brick building still dominates Castle Hill. The Cathedral Plaza is a convenient parking place for visitors wandering among the many historic buildings grouped on the Hill.

sidewalk and you return on the opposite side; otherwise you might find yourself pushed into the middle of the street.

Many of the young girls I observed were beautiful natural blondes, and drugstore complexions were the exception.

In my wanderings I passed the old, fat, complacent-looking watch tower called "Kiek-in-de-Kök" (Peep-into-the-Kitchen). Did people actually climb up this tower to watch dutiful housewives prepare their meals? I, for one, would not enjoy being inspected when I'm in the act of burning my food or fingers, but, then, perhaps Estonian housewives were far too efficient for such misfortunes.

LONG HERMAN AND STOUT MARGARET

A contrast to Kiek-in-de-Kök is formed by "Pikk Hermann" (Long Herman), also a watch tower. Tall and slender, it rises above the other buildings. Another favorite of mine is the ancient bastion called "Stout Margaret."

Since I felt in need of refreshment before climbing the steep winding street to the Domberg (Castle or Cathedral Hill), I stopped at a café and after a steaming cup of coffee I undertook the strenuous climb.

An old legend has it that Linda, Kalevipoeg's mother, with great effort, brought the body of her husband, Kalev, to this place, and to protect him buried him under numerous rocks, thus forming the foundation of the Domberg.

The eye is first attracted by the Byzantine cupolas of the Greek Orthodox Church surrounded by weatherbeaten Danish fortifications, the tall spires of Protestant churches, and stately old houses. Various buildings which housed public institutions of the old nobility have been taken over by the Government for offices.

The old cathedral is rich in ancient stone monuments and ornate, artistic tombstones. Most impressive to me was an obelisk in multicolored marble, placed here in memory of Count Ferdinand von Tiesenhausen,

Photograph by Erka

ACROSS THE SWIFT-FLOWING NARVA, SWEDISH AND RUSSIAN BATTLEMENTS STILL FACE EACH OTHER

Today Herman Fortress, right, and Ivangorod are merely relics, a reminder of early war and conquest in the long, troubled history of Estonia.

Photograph from Consulate General of Estonia

SPIRES AND TOWERS PIERCE TALLINN'S SKELETONLIKE SKYLINE OF WHITE-LIMED RIDGEPOLES AND CHIMNEY STACKS

On Castle Hill, landmarks stretch in line—grayish tower and slender spire of the Church of St. Nicholas (left); resplendent Russian cathedral with beet-shaped domes; Long Herman Tower, like an up-ended cannon; and the Dome Church, dreaming over its battleflags and distinguished men.

Photograph by N. Nylander

SAILORS FAR OUT IN THE GULF OF FINLAND LOOK FOR ST. OLAF'S POINTED STEEPLE, TALLINN'S LANDMARK

Early merchants built the steeple to its height of 470 feet to attract attention to their town. In clear weather, the Finnish coast may be seen from the belfry. Roses in profusion now bloom on the old bastions, converted into terraced gardens.

Photograph by Pasi from Three Lions

COSTUMES SUCH AS NARVA FOLK PARADE HELPED KEEP ALIVE ESTONIAN NATIONAL SPIRIT DURING CENTURIES OF FOREIGN RULE

Photograph from Baroness Irina Ungern-Sternberg

BALTIC BEAUTY

Primitive designs on the hats are closely akin to those of early Sweden. These cheerful choristers at the National Singing Festival are from northern Estonia.

Aide-de-Camp of Alexander I, who gave his life in the battle of Austerlitz. Short but sad, the inscription reads simply: "From father to son."

On the Domberg stands the Capitol of Estonia. Although this is a modern building, its solid simplicity harmonizes with its medieval surroundings.

PRESIDENT PÄTS BORN ON A FARM

Equally substantial is Konstantin Päts, the eight-times elected head of the State (p. 804). His career has been a colorful one.

Son of a building contractor, the President was born on a farm near Pärnu. After studying law he entered politics and as editor of an Estonian newspaper, *Teataja,* he carried on an extensive propaganda in the interest of his people.

In the first Russian revolution, in 1905, Päts played an active part; he was forced to take refuge in Switzerland and later in Finland. After several years of exile he returned to St. Petersburg, but his political activities on behalf of Estonia caused so much trouble that he was threatened with expulsion to Siberia. Through the loyalty of his friends this sentence was commuted, and he finally returned to Tallinn.

Once again he established the Estonian newspaper and used it as a means of propaganda for his country and people. This unfaltering determination and singlemindedness are perhaps the outstanding traits of his character.

The President's pet hobby is his garden and farm, where he spends his leisure hours. Like much of the land in Estonia, his was not particularly fertile, but through persistent efforts he succeeded in growing American corn from seed presented by the United States envoy.

Early in its existence, in 1919, the Estonian Government carried out a far-reaching agrarian reform. The large estates, namely those which comprised more than 330 acres of cultivated land, were cut up and nationalized, the land thus acquired being divided among the landless popula-

tion. This measure naturally caused hard feeling among the proprietors of the manorial estates, who required some time to readjust themselves to new conditions.

I must confess, however, that I was greatly impressed by the way such difficult problems as this had been handled. I have never been in a country where minorities (in this case chiefly Germans, Russians, and Swedes) were treated with such fairness as in Estonia. Jews referred to Estonia as a "golden" country. People with initiative and the will to work could make a living, though it might not be a luxurious one.

For instance, I visited the home of a former officer of the Imperial Army. I climbed three flights of stairs until I reached his little attic apartment, consisting of a small anteroom or workshop, a combination drawing and sitting room, and a small kitchen.

Photograph by Herman de Wetter

"AUTOMOBILES KEEP OUT," THE WHITE MARKER WARNS

The disk is one of numerous international traffic signals, adopted by many European countries to replace lettered signs. Only pedestrians are permitted in this narrow Lower Town shopping lane. Small stores are in basements, the shopkeepers usually living above.

This officer is an artist in wood carving and earns his living by making the most delightful wooden toys of unexcelled craftsmanship. His work has been sold in some of the leading shops of Tallinn, and he apologetically told me that often the demand exceeded the supply. His wife helps keep the wolf from the door by sewing. It is true that sometimes their meals were scanty, but on the whole, they told me, they really had nothing about which to complain.

Partly as a result of the ravages of war, a scarcity of food products was felt for a while in the early stages of the agrarian program. It was then that the Estonian co-operative movement, which had already existed for some time, helped immeasurably. There are co-operative dairies, slaughter houses, egg marketing societies, potato societies, peat societies, and so on. Because of the high prices of fuel immediately after the war, peat has been used extensively.

Of importance are the societies for the use of agricultural machinery; many of the small farmers without these co-operative or-

Photograph by Erka

AN ANCIENT CASTLE CROWNS THE DOMBERG, HIGHEST POINT IN TALLINN

German Knights of the Sword kept watch from the battlements of the fortress, and from the top of Long Herman (right) in the thirteenth century. The castle was restored after the World War. Today it houses government offices. Parks and promenades surround the thick walls and swans glide over the waters of the old moat.

ganizations would not be able to use modern agricultural machinery.

Estonia's farms have doubled in number since freedom was won. Not only have former estates been divided, but moors are being drained and government land is being opened to settlement, with heads of large families preferred.

MUCH OF ESTONIA'S WEALTH IS IN TREES

Estonia, 20 per cent forest-covered, is one of the fortunate countries in which the annual forest growth is greater than the domestic requirement, and therefore timber and wood products are exported in large quantities.

Numerous are the sawmills and pulp mills which consume the yield of coniferous forests. Furniture and plywood are made chiefly from birch. The largest furniture works are in Tallinn.

Aspen wood is used in the match industry, which has been greatly developed within the last few years. Speaking of matches, I must mention the excellent cigarettes manufactured in Estonia.

One of the most important industries is that of oil shale, which yields asphalt, pitch, lubricating and impregnating oils, fuel oil, and even benzine and gasoline for motor cars and planes. The most extensive oil shale works belong to the Government.

In peace time a lively import and export trade is carried on with Great Britain. Timber, butter, eggs, and bacon are exported, while machinery and cars are imported. Estonia's two best customers, normally, are the United Kingdom and Germany.

Photograph by Maynard Owen Williams

COALING SHIP IS WOMEN'S WORK, TOO

They fill the hampers, which the men carry from lighter to liner in Tallinn's harbor. More than two centuries ago, Peter the Great made the city (then Reval) a naval base and by 1912 Russia had so enlarged the shipyards that big battleships could be built there. Since the World War the port has bustled with commercial shipping.

It was my privilege to visit a weaving workroom where old Estonian designs are revived in modern articles like mufflers, sweaters, caps, tablecloths, bedspreads, and gloves; a pair of gloves with a border of reindeer fascinated me. The different national costumes are still worn, but usually only on festive occasions (pages 806-7, 815-6, and 820).

Also very attractive are the handmade leather goods, on which are used old, original Estonian designs, showing a pronounced Scandinavian influence.

ROUGH-RIDING BY BUS

Estonia now has 5,000 automobiles.

The roads of the country are being vastly improved and the present bus service is being extended. The busses themselves are comfortable and are strongly built to withstand the rough roads. But oh, what bumps! Once when passing through a deep mud hole, I closed the window just in time to avoid being spattered.

The busses have, or at least take, the right of way on all roads. Whenever a farmer driving his horse and cart sees a bus from afar, he simply drives into the near-by ditch, jumps off, covers the horse's eyes with a cloth, and hopes the noise of the engine will not upset his nervous steed—especially if his load consists of honey and eggs!

Since this is chiefly an agricultural country, it cannot boast of many cities. Besides Tallinn and Pärnu, only Tartu and Narva are of major importance.

Tartu, on both banks of the Ema River, is an old university town founded by Gustavus Adolphus. Here an atmosphere of wisdom and knowledge prevails. The shady

Photograph by Gustav Heurlin

SILVER BREAST SHIELDS WORN BY THESE ESTONIAN CHORISTERS WEIGH ABOUT A POUND AND A HALF EACH

Dressed in national costume, they have come to Tallinn from the hinterland to take part in the Singing Festival (page 834). Originally, even heavier shields and necklaces were worn. The museum at Tartu lists eighty distinct varieties of garb.

park of the cathedral hill provides the students with a quiet spot where they can discuss personal and world problems with kindred spirits or ponder over them in undisturbed solitude.

Not long ago the number of students was reduced from five thousand to three thousand by making the entrance examinations exceedingly difficult. To meet the demand for persons with technical knowledge a Technical University was recently established in Tallinn.

For centuries the cathedral hill has been looked upon as a holy place. Even now, not far from the old cathedral, ruins of sacrificial stones can be seen. The two banks of the river are connected with an arched stone bridge built there toward the end of the 18th century. Inscriptions glorifying the memory of Catherine the Great of Russia are carved in the gray granite (page 823).

Near the town is the Estonian National Museum, where are found the greatest treasures of Estonian art, while the University Library and the Central State Archives contain historic material of tremendous value. I wish I could have spent days there.

Here one can find data concerning those kinsmen of the Finns and Estonians, the almost extinct tribes of the Kurs and Livs. The latter have been especially interesting to me because an ancestor of mine, a Baron Ungern-Sternberg, married the daughter of one of their chiefs.

THE LIVS, A VANISHING PEOPLE

It was my great pleasure and honor to meet a real Liv, Mr. Stahler. He was well over six feet tall, slender, with intelligent steel-gray eyes—in short, an awe-inspiring person; but an occasional smile and a twinkle soon put me at ease while we carried on a lively conversation in German.

"Why are you so interested in my people?" he asked. "After all, there are only about six thousand of us left today, and we play no part whatsoever in the present activities of the world at large."

"My inborn curiosity, for one thing," I replied, "and also because as a child I spent hours reading about your people. Their heroic deeds when fighting for their freedom

Photograph by Joh. Triefeldt

WIND AND WAVE CARVE AN OVERHANGING CLIFF ON ESTONIA'S COAST

Beside the Gulf of Finland extends the precipitous limestone scarp called the Glint, nearly 200 feet high. Here and there stretch flat valley mouths or broad sand beaches. Country homes of the old Russian aristocracy once crowned lookout points along this steep north coast.

Photograph by Herman de Wetter

TIME OUT FOR DOBBIN'S LUNCH

The arch over the shafts is inherited from the bow of the old Russian droshky. A bow was placed also over the center horse of the famous Russian troika, or team of three horses abreast.

against the German knights thrilled me almost as much as my beloved red Indian stories. Ever since that day I have hoped the time might come when I could write about your people." Also, I told him that I, too, had Liv blood in my veins.

"I'll do my best," answered Mr. Stahler. "Without doubt we have received our name of 'Livs' from the Estonian word 'Liiv,' which means 'sand,' since most of my ancestors settled close to the seashore. Fishing was their main occupation. In small wooden home-made sailing boats they traveled from our Baltic shores often as far as Sweden.

"Both men and women were fearless, energetic, and exceedingly proud. Like myself they were tall and slender; a fat and jovial Liv was unknown. They liked to show their superiority by riding whenever they could, since walking did not seem to them very dignified.

"They fought for their freedom against the invading German forces with all their strength, while the Estonians and Letts finally made the best of a bad situation. It is contended that for this reason the latter continued to exist while we have practically died out.

"In the village where I was born," he concluded, "my grandmother was the last proud owner of beehives. Common belief would have it that people envious of my grandmother's comparative prosperity employed witchcraft and sent evil spirits in the form of birds, who destroyed all the bees. You may believe it or not, but the fact remains that ever since that time all attempts at raising bees in my native village have failed.

"And," he added whimsically, "soon we too will disappear, though perhaps not like my grandmother's bees—through witchcraft!"

AT NARVA EAST MEETS WEST

A town of importance is Narva, on the eastern frontier facing Ivangorod, the Russian fortress built in the 15th century. In this city East and West face each

Photograph by K. Akel

CATHERINE II OF RUSSIA BUILT TARTU'S GRANITE BRIDGE ACROSS THE EMA

The old University, looming beyond, had five thousand students a few years ago, but now the number has been reduced to three thousand by making entrance requirements more difficult.

Photograph by De Cou from Galloway

FRAGRANT ODORS OF FRESH-BAKED LOAVES TANTALIZE BUYERS

Bakers take over one corner of Tallinn's open-air market, close to the National Theater building (page 804). The tower of St. Nicholas Church (page 813) rises in right background.

Photograph by N. Nylander

SLEIGH BELLS JINGLE IN TALLINN'S BROAD MARKET SQUARE

Outdoor venders' booths have retreated before the snowstorm, a common occurrence in December and January. The latter month is the coldest, with mean temperature of 20 degrees Fahrenheit.

Photograph by Parikas

"OIL WELLS" IN ESTONIA ARE UNDERGROUND MINES

Several shafts at Kohtla drive deep into the oil shale. Countries with easy access to petroleum and coal fields have not exploited shale because manufacturing costs are too high. Estonia, lacking such resources, and forced to import fuel at high prices, found it cheaper to produce crude oil, gasoline, and other products by distilling shale. Now she has met all domestic needs.

Photograph by Pasi from Three Lions

OIL SHALE IS ESTONIAN GOLD

Close to the surface lie most of the deposits, which are removed to refineries for distillation. Such a process is not new, for Scotland has distilled shale for many years. Germany, at the outbreak of the present war, was producing about 60 per cent of her required supply of gasoline by distilling brown coal, and had hoped to be self-sufficient in 1942. Estonian shale yields from 18 to 20 per cent of crude oil, a much higher ratio than either Scottish shale or German coal. The United States has immense supplies of undeveloped oil shale in Colorado and Utah.

other, so that Narva has long been an object of dispute and more than once it has been destroyed by fire and wars. In spite of this, it has always been reconstructed in its original baroque style (page 812).

The only reminder of medieval times is the Greek Orthodox Cathedral which was originally built as a Roman Catholic church during the 14th century. Other buildings of interest include the castle of Peter the Great and the Church of St. John.

WATER POWER DRIVES SPINDLES

A short distance up the river the waters of Lake Peipsi, 55 miles long and half as wide, take a tumble of from 26 to 33 feet. Some of the available power is used to drive the Kreenholm Cotton Mills, with 450,000 spindles.

During the German occupation in the World War, it worried the Teutons to find that only one-sixth of the total power of these falls was being used. The Estonians now utilize 25,000 out of a possible 90,000 horsepower, but peat-burning power-plants provide more than a fourth of Estonia's electric energy.

Narva should be visited in the summer when it is possible to ride down the stream to Narva-Jõesuu, a beach resort at the mouth of the river.

Downstream the Narva is quiet, as if resting from its powerful gymnastics at Kreenholm. Here women tie golden grain into sheaves or dig potatoes, and men pull lustily at rude oars or hang brown nets to dry on weathered frames.

Along the sandy seashore at Narva-Jõesuu you may wander for hours, and when you grow tired of the monotony of waves and sand you can turn your steps inland and lose yourself in a tall pine forest.

In a few days I set out for southern Estonia where I wanted to visit the famous

Photograph by K. Akel

A LOWLY PRETZEL WEARS A KINGLY CROWN

The sign is hoisted outside a Tallinn bakery by a proprietor who lacks no confidence in the merit of his product. Small cakes, to go with coffee for afternoon or midnight snacks, are also popular.

old Russian monastery called in Estonian "Petseri" and in Russian "Pechory."

On the train I met an English-speaking Estonian. He told me that English was studied a great deal in his country, since the trade with England was annually gaining in importance.

ONE ESTONIAN'S IDEA OF AMERICA

"About your country, the United States," he continued, "we don't know a great deal." "Personally," he added, "I have never met an American, but I guess that doesn't matter so much. I don't believe the United States is as important as the British Isles; and I am sure that in another five hundred years all of you shall revert to red Indians again."

This statement rendered me completely speechless and being afraid of bursting into uncontrollable laughter I excused myself and said that it was time for me to retire for the night. Such a misconception, of course, is hardly typical.

PETSERI HAS A RUSSIAN AIR

Early in the morning I arrived in Petseri, a little town that seemed a part of Russia. Here I was met by a friend of my sister's, a delightful Russian lady who was living temporarily in the house of a Russian farmer, since the home she was having built for herself was not completed.

On our short trip to the little cottage, nearly every passerby lifted his hat to my hostess, greeting her in Russian with a smile. Here few spoke Estonian.

It was a bright sunny day, and from afar I saw the pale green, bright blue, and brick-red cupolas of the monastery, which is one of the very few in the world where Russian monastic life has been kept intact.

After breakfast my hostess, Sophia Michailovna, promised to be my guide. First of all she showed me her almost completed house where she was planning to spend the rest of her life. Since her children were all grown and married and her husband dead, she had decided to dedicate

her remaining years to writing books on the Petseri monastery and to making illustrations of the art treasures kept there.

"This is a great task I have set for myself," she said laughingly, "but I think that I'll be still good for another ten years. I don't think I will ever bring this work to an end, but perhaps I'll be able to publish at least one volume and awaken interest in the soul of another art lover, who will complete that which I have started."

Her house, located on a hill, contained a large, sunny studio on the second floor from where, even through the dense foliage of lovely old trees, she commanded a perfect view of the monastery.

"You see, early in the morning I will be awakened by the chimes from the monastery calling me to mass, since, after all, it's only a short walk; and refreshed by prayer, I shall return inspired for the daily task I have set for myself." Truly rather a lovely way of spending one's remaining years on earth!

Photograph by Pasi from Three Lions

INTO THE KITCHEN HE RIDES TO INVITE WEDDING GUESTS

A relative of the bride, this man troops through the village, from house to house. Piloting his mount through the back door of each home, he recites from the saddle a rhymed invitation to the ceremony.

A TALISMAN FOR TOOTHACHE

Slowly we wandered to the monastery, in which there reigned an atmosphere of extraordinary peace. We entered the gates and suddenly I felt myself cut off from the rest of the world as if walking in a dream. Had there really been a war and revolution? If so, they had left no trace here, where about forty monks cheerfully fulfilled their daily tasks. A monk in black garb was painting the fence, while another was watching over the old well in the center of the yard.

Part of the monastery has been built right into the side of a sandstone cliff. The story goes that the early Christians here made themselves caves in which they lived in comparative safety from attacks by their heathen neighbors. During summer nights they ventured out to chant and say their prayers in the heavy shade of mighty oak trees. For a long time they were thought

Photograph by K. Akel

ESTONIA'S PRESIDENT GREETS WOMEN'S DEFENSE LEAGUE OFFICERS FROM THE BALCONY OF KADRIORG PALACE

The white-clad leaders announce arrival of several regiments of the feminine military organization for a review. A regular army unit is lined up as a guard of honor. The palace was erected by Peter the Great for his wife, Catherine. It was reconditioned in 1929 as a summer residence for President Päts (pages 804 and 833).

Photograph by Voolman

"MY FATHERLAND, MY FORTUNE AND JOY, HOW BEAUTIFUL THOU ART!"

Estonian choristers, 17,000 strong, join in the national anthem at the giant Singing Festival held in Tallinn in June, 1938. Every five years, for more than half a century, such huge gatherings have united in singing folk songs "born of the clouds and cold of the north" (page 834). Dressed in national costume, 560 choirs took part in the festivities which marked the twentieth anniversary of independence, before audiences of 100,000. Estonia's songfests, during the days of Russian rule, expressed in music the national aspirations of the people.

Photograph by K. Akel

IN PETSERI, WHERE TIME STANDS STILL, A CHURCH PROCESSION PASSES

The author was awakened by the mellow sound of monastery bells in this Russian village in Estonia. From her window she watched processions winding toward the old cathedral. Roofs and domes gleam with copper and gold. Old ikons in the catacombs mark the stations of the cross. The monastery is a place of pilgrimage for the minority group of Russians who form about 8½ per cent of the Estonian population.

Photograph by K. Akel

SETU PILGRIMS IN LONG WHITE CLOAKS REACH PETSERI

Upon entering the Russian church, the farm women will prostrate themselves on the bare floor. After the service these folk, part-Estonian, part-Russian, gather in small eating places to play harmonicas, sing, and gossip.

to be specters, and the neighboring people stood in awe and fear; the oaks were regarded as holy.

I was offered a piece of bark from one of these mighty trees and was solemnly requested to carry it with me always because it would be an unfailing talisman; it had healing qualities and would cure me in no time, particularly of toothaches or heart ailment!

Gradually these early Christians built themselves a church and were joined by others, and thus the monastery was founded. As time went on, more churches and cells for the monks were added, but some of the original catacombs are still intact. With Sophia Michailovna I wandered through them. At each side rest the remains of monks, and as we carried our little wax tapers through these long, damp corridors it was uncomfortable and gruesome.

We finally reached a corridor in which the ground looked as if it had been freshly hollowed out and Sophia Michailovna turned smiling to me.

"I have done this," she said, and then she led me to a little underground chapel, where a red flame burned before an ikon.

"I have had this little chapel built in memory of my husband and his family, and if you step up to the right you will see an empty niche where some day I, too, hope to rest in my eternal sleep."

A LEGEND OF IVAN THE TERRIBLE

With Father Basil we visited the treasure room, kept under lock and key. Here we saw an embroidery made by the wife of Ivan the Terrible to seek God's forgiveness for a crime her illustrious and cruel husband had inadvertently (for once) committed.

Legend says that when the monks started building a wall around their monastery to protect themselves from the German knights, who had built a stronghold near by, Ivan the Terrible was informed by an ill advisor that here at Petseri some monks were erecting a fortress against him.

The Tsar set out at once to visit the monastery. When greeted by the monks, he pulled out his sword and with one blow severed the head of the Father Superior, much to the consternation of the assembly. But, believe it or not, the Father Superior, evidently not so much surprised as the others, then picked up his head and non-

© Douglas Chandler

PATRIARCH OF PETSERI

Strummed balalaikas are heard in this village near the Soviet border where the customs of old Russia have been preserved.

chalantly walked to his eternal resting place in the catacombs.

Ivan the Terrible, when informed of his mistake, repented and presented to the monastery this marvelous embroidery made by his wife.

BARBED WIRE MARKS THE RUSSIAN BORDER

Later we hired a car to take us to Irboska, where there are famous old ruins of a castle and a Russian church. Here lies buried Truvor, one of the three Variagi who came to Russia in the 9th century and are known as the founders of the State of Russia.

On our way the chauffeur stopped the car and showed us the outlines of the city of Pskov lying across the frontier in Soviet Russia, which was separated from Estonia by barbed wire. It was a strange sensation to me to be so near Russia and yet so far. In this part of Estonia the schools are all conducted in Russian, and the Estonian government extends a great deal of material help to the Russian poor.

From Irboska we drove on to the estate of Sophia Michailovna, which she had turned over to her daughter and son-in-law. As luck would have it, when the frontier line was drawn, this country estate still came within the boundaries of Estonia, a scant two miles from Soviet Russia.

The old manor house had been destroyed and for some time the fields had not been tilled, but a year ago a new house was built, combining old-fashioned comfort with modern conveniences.

I was deeply impressed by so much courage and optimism, because after all, here as in nearly all of Europe, the future is very uncertain. But life has to go on, and we cannot always be afraid of what *might* be.

When I returned to Tallinn, I was called on the telephone by Mrs. Harold E. Carlson, whose husband was then United States chargé d'affaires. She wished to inform me that Mrs. Laidoner, the wife of the

Commander-in-Chief of the Estonian Army, had invited us to tea that afternoon. General Laidoner, who commanded the army against the Soviet troops during Estonia's war of independence, is responsible for both internal and external peace, and is the President's right-hand man.

On the way to Pirita (the bathing resort of Tallinn), near which the General's manor house is located, one passes Kadriorg, Tallinn's "Hyde Park," which was planted by Peter the Great and continued by his successors. Here, in a beautiful background of old chestnut and lime trees, stands the palace of the same name, at present occupied by the President (page 828).

Photograph by Pasi from Three Lions

WOMEN PUNCH TROLLEY TICKETS IN TALLINN

They have invaded many fields once considered for men only. Many work in Tallinn's banks and offices, or in the building trades and at other manual labor.

In the middle of the park is a small Dutch house, in which Tsar Peter lived for a while. If you doubt it, peep under the bed and you will see his bedroom slippers standing there just where he put them! Close behind the cottage is the bath house which the Tsar himself is said to have built.

THOROUGHBREDS NOT "COCKTAIL DOGS"

Having arrived at the manor house we rang the bell and the door was opened by an Estonian maid. At her sides stood two fierce-looking bulldogs which barked furiously at the sight of us. With the aid of gestures we tried to explain to the servant that Madame Laidoner was expecting us, while she in turn tried to convey to us that the dogs were harmless. We entered a beautiful reception room, followed by the barking dogs, but since they were wagging their tails, both Mrs. Carlson and I thought it safe to sit down.

Presently Madame Laidoner, our charming hostess, appeared. She greeted us with a smile and said, "I hope you do not mind the dogs, but they are pure bred and not cocktail dogs!"

"Cocktail dogs?" I inquired, puzzled.

"Yes," said Madame Laidoner, "they have not been mixed. Don't you use that expression in America?"

Madame Laidoner is a Russian by birth

and, though she has many accomplishments, she is proudest that she has mastered Estonian and speaks it fluently.

She told me much about the work of the Children's Kitchens in which she takes keen personal interest. Here daily two thousand children receive a meal either gratis or for only a small sum. This is necessary because of the large number of orphans or children from poor families.

In Estonia there are a number of women's clubs which have organized many charities, and in the provinces free lectures on housekeeping and farming are provided.

The most popular women's organization is the Women's National Defense League, to which 15,000 women belong. Their task is to look after the children and sanitation, and to help the army by supervising canteens and by giving Red Cross help.

Women in Estonia enjoy the same rights as men and work side by side with them. They have not been appointed judges nor have they held cabinet positions, but they vote and take a keen interest in politics.

YOUTH HAS ITS WAY IN LOVE

When I asked a young Estonian if children consult their parents when courting and marrying, he said, "In principle, yes. Our tradition still has it that both father and mother must be obeyed in all matters, but in reality youth has its own way, and does in matters of the heart very much as it pleases."

Before I left Tallinn I visited the "English College," which was founded in 1932 by Madame Anna Törwand-Tellmann. In this institution, as its name denotes, much stress is laid on the study of English, and subjects which deal with the United States and England are taught in this language. More than 500 pupils attend the college, and thus the youth of Estonia is given the opportunity of studying English thoroughly.

The Anglo-Estonian Society, which was founded seven years ago, now has several hundred members. The principal purpose is to afford an opportunity to hear good English. The society has its own small library and has recently sponsored a theatrical group, which gives short English plays.

LANDOWNER'S LIFE, NEW STYLE

Before leaving the country I spent some time on my sister's estate, not far from Tallinn. Part of this property, including the main manor house, has been nationalized through the agrarian reforms. Under the law of March 1, 1926, landowners were allowed to retain a part of the nationalized land and were compensated for their property.

Now living in a smaller place very beautifully arranged, my sister has her own horses and cattle and is running a profitable dairy. I noticed with especial pleasure her excellent relations with the neighboring farmers, who often came to her for advice which she gladly gave.

Of course life is not so easy as in the old days and pennies have to be counted. But what of it, so long as one is reasonably happy? My sister's eldest daughter, who is in charge of the fruit and vegetable garden, drives the products herself to market, and sells them from her cart as proudly and happily as any landowner can.

Their house is comfortable in comparison with those of many of their neighbors, and they will "get along."

Not many years ago you could still find people living in mud houses, a hole in the wall serving as chimney. These huts have disappeared and are replaced by more modern houses, though one still sees many log houses with thatched roofs.

During the summer the farm women work in the fields beside their husbands; and during the winter they spin, weave, and knit. Some of the simple garden tools, like brooms and rakes, are homemade, but they serve their purpose, and are inexpensive.

GOD OF SONGS STILL LIVES

Estonians excel in singing, which for many centuries was their only means of national self expression. This is a country of "singing clubs," where even the railway officials have a choir. The small city of Tallinn, aided by the Government, even supports an opera house (page 804).

Most prominent of all the singing clubs is the Estonian Singers Association which helps to organize the great song festival, held every five years. In 1938 some 17,000 persons from all parts of the country came to Tallinn to sing (page 829).

When thousands of Estonian voices unite in singing folk songs born of the clouds and cold of the north, one senses the power that lies within—the willingness to suffer rather than yield. It is in the Estonian voice that the national soul is revealed, deep, patient, and full of faith.